HORIZONTAL STABILIZER TRIM SYSTEM - MAINTENANCE PRACTICES

1. Adjustment/Test Adjust Horizontal Stabilizer Trim System (see Figure 201)

A. Horizontal Stabilizer Travel Data (See Figure 202).

(1) General.

Angular measurements are taken with a protractor installed on the trailing edge of the stabilizer, outboard of the elevator. A linear measurement is the straight line distance, in inches, between the noted point on the surface in the streamline position and the same point on the surface in the deflected position.

B. Equipment Required.

(1) External source of 115/200-volt, 400-cps, ac electrical power.

(2) Hydraulic test stand to pressurize airplane's hydraulic systems.

(3) Standard cable tensiometer for measuring tension of 3/32-inch 7 x 7 control cable.

(4) Thermometer calibrated in degrees F or C.

(5) Protractor No. 30-00003-901 RGTL #1 for measuring angle of stabilizer deflection (see 27-5-0, Figure 203).

(6) Stands suitable for reaching side and bottom tail cone and forward fuselage access doors.

(7) One index pin No. 22-J107-1 and one index pin No. 22-J107-2.

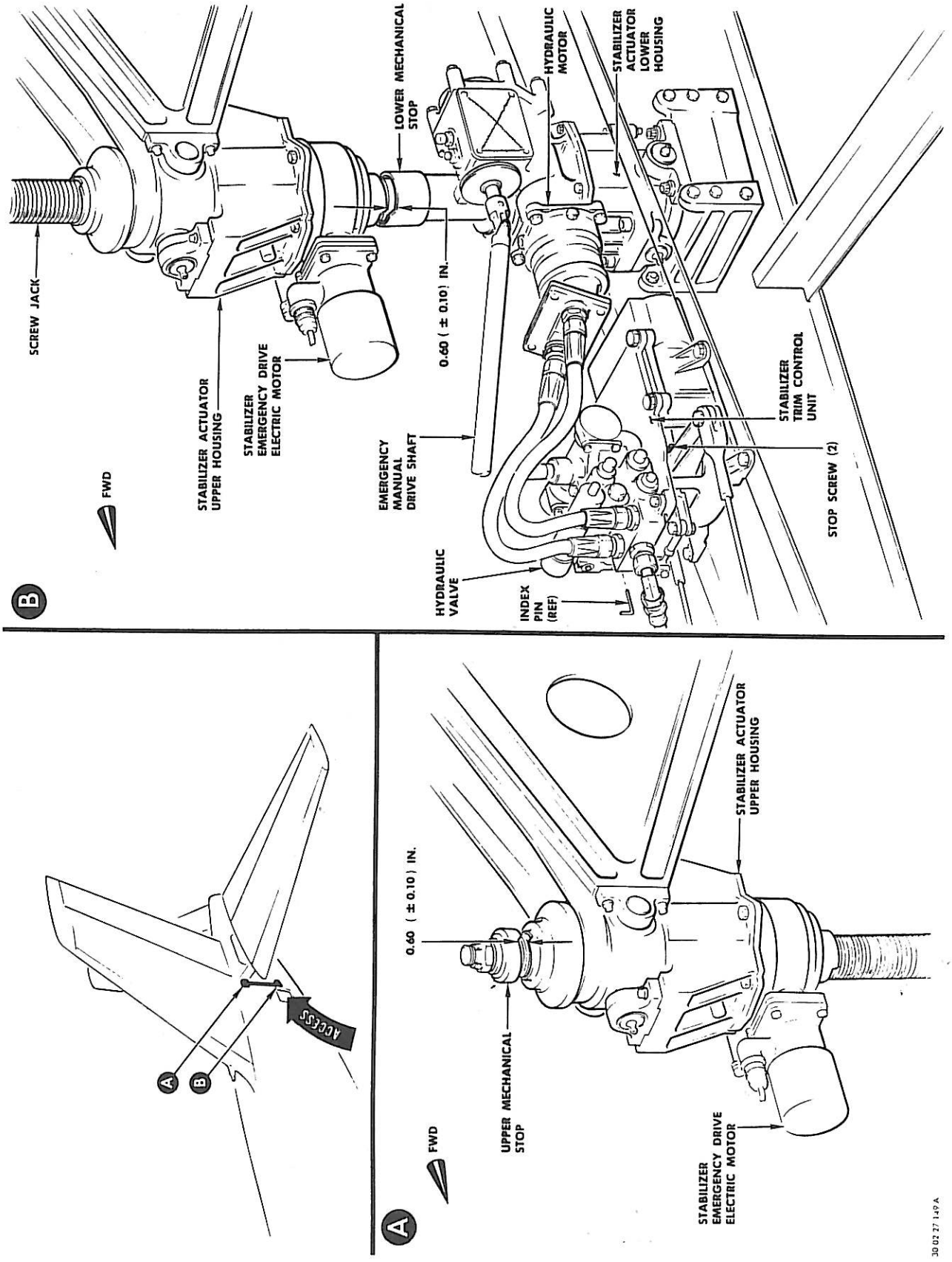
C. Preparation.

(1) Check area for any obstruction that might interfere with operation of horizontal stabilizer, trailing edge flaps, or leading edge flaps.

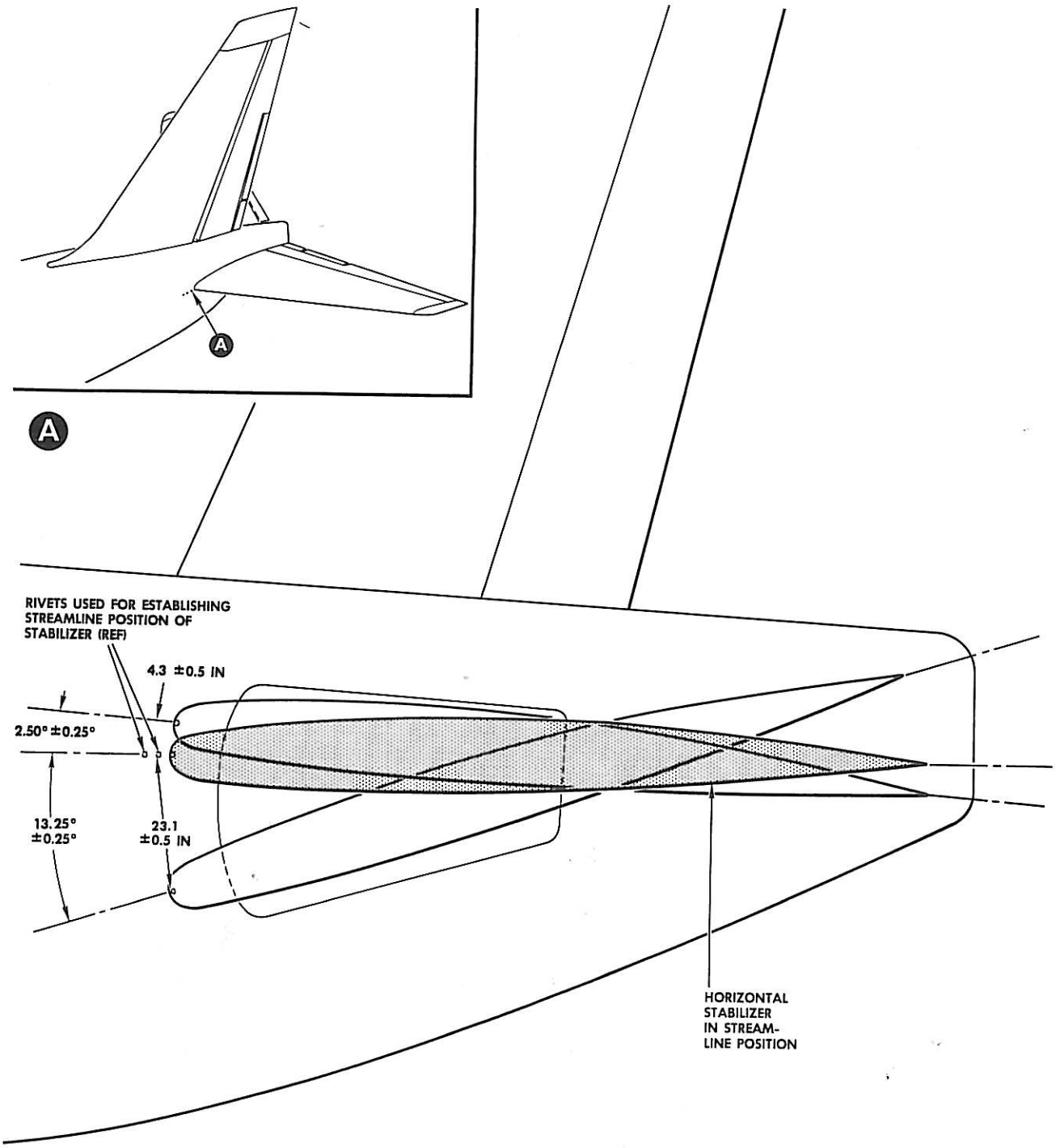
(2) Connect external source of hydraulic power and pressurize both airplane hydraulic systems (refer to Chapter 29, HYDRAULIC POWER).

(3) Connect external source of electric power and energize airplane electrical system (refer to Chapter 24, ELECTRICAL POWER).

(4) Open side and bottom tail cone and forward fuselage access doors.



Horizontal Stabilizer
Trim System Adjustment
Figure 201



ANGULAR DEFLECTION	LINEAR DEFLECTION	LOCATION OF POINT ON SURFACE FOR DETERMINING LINEAR MEASUREMENTS
DOWN 13.25° ±0.25° UP 2.50° ±0.25°	DOWN 23.1 ±0.5 INCH UP 4.3 ±0.5 INCH	SEE NOTE 1

NOTE 1: HORIZONTAL STABILIZER LINEAR MEASUREMENT IS TAKEN BETWEEN HOLE IN HORIZONTAL STABILIZER INBOARD LEADING EDGE AND AFT RIVET USED FOR DETERMINING STABILIZER STREAMLINE POSITION.

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D. Adjust Stabilizer Trim Cable Systems.

(1) Insert index pin 22-J107-1 in stabilizer control valve input arm.

(2) Adjust tension of stabilizer trim control cables to 85 (±10) pounds at 70 degrees F (21 degrees C). Increase or decrease specified cable tension 0.5 pound for each degree F (1.0 pound for each degree C) increase or decrease respectively in free air temperature.

NOTE: Measure tension of flexible sections of cables with standard tensiometer.

(3) Attempt to insert index pin 22-J107-2 through stabilizer trim lever on pilots' pedestal. If index pin cannot be inserted, alternately loosen and tighten opposing cables until index pin can be inserted through trim lever.

(4) Recheck tension of trim control cables, adjust if necessary, and safety turnbuckles with NAS 651 clips.

(5) Remove index pin from stabilizer trim lever.

(6) Using emergency trim hand crank, raise leading edge of stabilizer to full "nose down" position.

(7)*Adjust tension of stabilizer control limit cables between control unit and roof of tail cone to 85 (±10) pounds at 70 degrees F (21 degrees C). Increase or decrease specified cable tension 0.25 pound for each degree F (0.50 pound for each degree C) increase or decrease respectively in free air temperature.

(8)**Adjust preliminary tension of stabilizer control limit cables to 50 (±10) pounds. No temperature compensation required at this time.

(9) Deleted.

(10) Deleted.

(11)*Safety control limit cable turnbuckles with NAS 651 clips.

* Applicable to airplanes CV5, CV6, and CV28 through CV31 until Service Bulletin 27-5 has been incorporated.

** Applicable to airplanes CV1 through CV4, CV7 through CV27, and CV32 and on. Also applicable to airplanes CV5, CV6, and CV28 through CV31 after Service Bulletin 27-5 has been incorporated.

(12)*Adjust tension of stabilizer motion indicator cables to 50 (±5) pounds at 70 degrees F (21 degrees C). Increase or decrease specified cable tension 0.25 pound for each degree F (0.50 pound for each degree C) increase or decrease respectively in free air temperature.

(13)*Adjust length of motion indicator cables so that bottom chain at aft sprocket of motion indicator linkage extends 3 inches forward from centerline of large sprocket and bottom chain at forward sprocket extends 23.7 inches aft from centerline of forward sprocket.

(14)*Recheck tension of motion indicator cables, adjust as necessary, and safety with NAS 651 clips.

(15)**Adjust length of motion indicator cables so that bottom chain at forward sprocket extends 29.1 inches aft from forward sprocket; as measured between centerline of sprocket and centerline of pin connecting aft end of chain to cable end link.

(16)**Adjust tension of stabilizer motion indicator cables to approximately 50 pounds.

(17)**Using emergency trim hand crank, position stabilizer at 6.0 (±0.5) degrees airplane "nose up".

(18)**Increase tension of stabilizer control limit cables and motion indicator cables by tightening opposing cables equally to 55 (±5.0) pounds at 70 degrees F (21 degrees C). Increase or decrease specified cable tension 0.25 pound for each degree F (0.50 pounds for each degree C) increase or decrease respectively in free air temperature.

NOTE: Check tension in upper loop of control limit cables. Tension in lower loop will be approximately double the tension in upper loop.

(19)**Adjust stabilizer to 5 degrees airplane "nose up", then to 7 degrees airplane "nose up", and then back to 5 degrees airplane "nose up".

(20)**Recheck tension of control limit and motion indicator cables and adjust as necessary until tension of both sets of cables is within tolerance indicated.

(21) Safety turnbuckles in both cable systems with NAS 651 clips and remove index pin from stabilizer control valve input arm.

*Applicable to airplanes CV5, CV6, and CV28 through CV31 until Service Bulletin 27-5 has been incorporated.

**Applicable to airplanes CV1 through CV4, CV7 through CV27, and CV32 and on. Also applicable to airplanes CV5, CV6, and CV28 through CV31 after Service Bulletin 27-5 has been incorporated.

E. Adjust Stabilizer Trim Control Unit Stops (see Figure 201).

(1) Loosen lock nut and back off stop screw on control unit cam until end of screw is flush with stop screw lug. Turn stop screw on input bell crank as far as possible into bell crank. Screws are accessible through lever openings in base of control unit.

(2) Using emergency trim hand crank, actuate stabilizer in "leading edge up" direction until upper mechanical stops on stabilizer actuator make contact.

(3) Lower stabilizer leading edge until there is vertical gap of 0.60 (±0.10) inch between upper mechanical stops.

(4) Insert index pin 22-J107-1 in stabilizer trim hydraulic valve.

(5) Adjust stop screw on input bell crank until it just makes contact with striker pad on control unit cam.

(6) Actuate stabilizer in "leading edge down" direction until lower mechanical stops on stabilizer actuator make contact and then raise leading edge of stabilizer until there is gap of 0.60 (±0.10) inch between lower mechanical stops.

(7) Adjust stop screw on control unit cam until it just makes contact with striker pad on control unit bell crank. Tighten lock nut on stop screw.

(8) Remove index pin from hydraulic valve.

F. Adjust Stabilizer Position Transmitter and Limit Switches.

(1) Adjust stabilizer to 0-degree position by aligning reference hole in stabilizer leading edge with reference rivets in fuselage skin.

(2) Close STAB POS IND circuit breaker on main circuit breaker panel, install protractor, tool No. 30-00003-901 RGTL #1, on trailing edge of stabilizer, and adjust protractor to read 0°.

(3) Check position indicator on pilot's instrument panel. Indicator should read 0 (±0.50) degree. If indicator is not within tolerance, disconnect transmitter arm from transmitter splined shaft, rotate splined shaft to position resulting in 0-degree indicator reading, and reconnect transmitter arm. Make sure that transmitter shaft and indicator rotate in the same direction.

(4) Adjust length of transmitter control rod so that angle between control rod and transmitter arm is 70 (±3.0) degrees when arm is installed on transmitter shaft.

(5) Check position indicator reading on pilot's instrument panel to make sure that position of transmitter shaft has not been changed.

(6) Position stabilizer successively at 2-1/2 degrees "trailing edge down", 0, 2-1/2, 5, 10, and 13.25 degrees "trailing edge up". Check position indicator reading at each position. Indicator should read within ±0.5 degree, of each stabilizer setting. Adjust length of transmitter control rod, if necessary, so that all position indicator readings vary in the same direction from stabilizer protractor readings.

(7) Deleted.

(8) Adjust position of warning horn switch so that it is closed by warning horn cam except when stabilizer is positioned between 0.75 (+0.5, -0.0) "trailing edge down" and 7.0 (+0.5, -0.0) degrees "trailing edge up".

(9) Adjust position of stabilizer trailing edge up and down limit switches so that they are opened when gap between mechanical stops is 0.62 (±0.19) inch at extremes of stabilizer travel.

(10) Remove protractor from stabilizer trailing edge.

2. Adjustment/Test Stabilizer Trim System Bleeding Procedure

A. General.

After breaking into or replacing a component of the stabilizer hydraulic system, the hydraulic system must be bled to remove any entrapped air.

B. Equipment Required.

(1) External source of hydraulic power.

C. Bleed Stabilizer Trim Hydraulic System.

(1) Connect external source of hydraulic power to airplane and pressurize hydraulic systems (refer to Chapter 29, HYDRAULIC POWER).

(2) Check that area of stabilizer is free of obstructions.

(3) Using pilot's stabilizer trim lever, cycle stabilizer three times from full "nose up" to "nose down" to "nose up" position.

NOTE: Monitor No. 1 reservoir hydraulic gage constantly. If fluid level rises to top of sight gage, stop stabilizer cycling operation temporarily until fluid level returns to FULL on gage.

(4) Return airplane to normal configration.

3. Adjustment/Test Stabilizer Trim System Functional Test

A. Equipment Required.

(1) External source of 115/200-volt, 400 cps, ac electrical power.

(2) External source of hydraulic power.

(3) Standard cable tensiometer for measuring tension of 3/32-inch 7 x 7 flexible cable.

(4) Thermometer calibrated in degrees F or C.

(5) Protractor No. 30-00003-901 RGTL #1 for measuring stabilizer travel.

(6) Stop watch.

(7) Force measuring device and adapter, tool No. 30-43700, capable of measuring force required to rotate emergency trim crank up to 115 inch-pounds. Adapter shall also be used when measuring engage and disengage forces of emergency trim shaft detent.

(8) Spring scale, calibrated from 0 to 15 pounds, for measuring force required to actuate stabilizer trim levers as measured at uppermost point of levers.

(9) Interphone headsets for communicating between cockpit and tail cone area of airplane.

B. Pre-Operational Checkout.

(1) Visually inspect all fairleads, pulleys, cable drums, cable guards, terminals, pressure seals, turnbuckles, etc., for proper installation. All installations requiring safety wire shall be properly safety wired.

(2) Check that all 3/32-inch 1 x 19 cables are wound in right-hand lay.

NOTE: If 1 x 19 cables with standard lay are joined to 7 x 7 cables, the cable will tend to unwind under tension.

(3) Using standard cable tensiometer, check that tension of 7 x 7 stabilizer trim control cables is 85 (±10) pounds at 70 degrees F (21 degrees C.). Increase or decrease specified cable tension 0.50 pound for each degree F. (1.0 pound for each degree C.) increase or decrease respectively in free air temperature.

NOTE: Stabilizer shall be set at 7.5 degrees airplane "nose up" when conducting the foregoing tension check.

(4) *Using standard cable tensiometer on flexible sections of control limit cables, check that tension is 85 (±10) pounds at 70 degrees F (21 degrees C.). Increase or decrease specified cable tension 0.25 pound for each degree F. (0.50 pound for each degree C.) increase or decrease respectively in free air temperature.

(5) *Using standard cable tensiometer on flexible sections of cables, check that tension of stabilizer motion indicator cables is 50 (±5.0) pounds at 70 degrees F (21 degrees C). Increase or decrease specified cable tension 0.25 pound for each degree F (0.50 pound for each degree C) increase or decrease respectively in free air temperature. Check that cabin portion of cable loop is not twisted.

(6) **Using standard cable tensiometer on upper loop of stabilizer control limit cable system, check that tension is 55 (±5.0) pounds at 70 degrees F (21 degrees C). Increase or decrease specified cable tension 0.25 pound for each degree F (0.50 pound for each degree C) increase or decrease respectively in free air temperature.

NOTE: Tension in lower half of cable loop will be approximately double the tension in the upper loop.

(7) **Using standard cable tensiometer on flexible sections of motion indicator cables, check that tension is 55 (±5.0) pounds at 70 degrees F (21 degrees C). Increase or decrease specified cable tension 0.25 pound for each degree F (0.50 pound for each degree C) increase or decrease respectively in free air temperature. Check that chain portion of loop is not twisted.

(8) Connect external source of electrical power to airplane (refer to Chapter 24, ELECTRICAL POWER).

(9) Connect external source of hydraulic power to airplane and pressurize hydraulic systems (refer to Chapter 29, HYDRAULIC POWER).

(10) Actuate stabilizer to approximately 5 degrees airplane "nose up", then to approximately 7 degrees airplane "nose up", and then return stabilizer to 6 degrees airplane "nose up".

(11) Recheck tension of upper loop of stabilizer limit cables and motion indicator cables and adjust tension if necessary.

*Applicable to airplanes CV5, CV6, and CV28 through CV31 until Service Bulletin 27-5 has been incorporated.

**Applicable to airplanes CV1 through CV4, CV7 through CV27, and CV32 through CV37. Also applicable to airplanes CV5, CV6, and CV28 through CV31 after Service Bulletin 27-5 has been incorporated.

(12) If it was necessary to readjust tension of cables in step (11), repeat steps (10) and (11) until cable tension remains within tolerance.

(13) Check that stabilizer motion indicator clicks continuously while stabilizer motion indicator cable loop is in motion.

(14) Close STAB TRIM RATE CONT, AUTOPILOT TRIM RATE, STAB TRIM CONT EMER, MANUAL STAB TRIM, STAB POS IND, LG HAN SOLENOID, RH LG GROUND SAFETY, and WARN HORN circuit breakers on main circuit breaker panel.

C. Test Stabilizer Trim Indicator.

(1) Check that STAB POS IND circuit breaker is closed.

(2) Using stabilizer trim levers, adjust stabilizer until streamline reference rivets are aligned with hole in leading edge of stabilizer.

(3) Stabilizer position indicator on pilot's instrument panel shall read 0 (±0.50) degrees.

(4) Install protractor No. 30-00003-901 RGTL #1 on stabilizer trailing edge and adjust to read 0 degrees.

(5) Actuate and hold stabilizer trim lever full "nose down" until stabilizer stops moving. Indicator shall read the same as protractor within 0.50 degree.

(6) Actuate and hold stabilizer trim lever full "nose up" until stabilizer stops moving. Indicator shall read the same as protractor within 0.50 degree.

(7) Deleted.

D. Test Stabilizer Trim Levers.

(1) Hold pilot's stabilizer trim lever in full aft position. Stabilizer shall move slowly in airplane "nose up" direction and trim levers shall return to neutral as stabilizer reaches full "nose up" position.

(2) Gap between actuator mechanical stops shall be 0.60 (±0.10) inch when stabilizer stops moving.

NOTE: Do not resist movement of levers toward neutral as stabilizer approaches full travel position.

(3) Hold pilot's stabilizer trim lever in full forward position. Stabilizer shall move slowly in "nose down" direction and trim levers shall return to neutral as stabilizer reaches full airplane "nose down" position. Gap between actuator mechanical stops shall be 0.60 (±0.10) inch when stabilizer stops moving.

(4) Attach spring scale to pilot's or copilot's stabilizer trim lever and move trim lever aft slowly until stabilizer begins to move. Force required to initiate stabilizer movement shall be 5 to 9 pounds.

(5) Release force on stabilizer trim lever. Lever shall return to neutral and stabilizer shall stop moving.

(6) Using spring scale, move trim lever forward slowly until stabilizer starts to move. Force required to initiate stabilizer movement shall be 5 to 9 pounds.

(7) Release force on stabilizer trim lever. Lever shall return to neutral and stabilizer shall stop moving.

(8) Remove spring scale from trim lever.

E. Test Horizontal Stabilizer Manual Trim Rates.

(1) Actuate and hold pilot's or copilot's stabilizer trim lever full aft until stabilizer reaches full airplane "nose up" position and trim lever is returned to neutral.

(2) Actuate and hold trim lever full forward until stabilizer reaches full airplane "nose down" position.

(3) Using stop watch, check that time required for stabilizer to move from full "nose up" to 0-degree position is from 45 to 87 seconds.

(4) Check that stabilizer motion indicator rotates in airplane "nose down" direction while stabilizer is moving in airplane "nose down" direction and that indicator clicks continuously while stabilizer is in motion.

(5) Starting with stabilizer in full "nose down" position, actuate and hold trim levers full aft until stabilizer reaches full airplane "nose up" position.

(6) Using stop watch, check that time required for stabilizer to move from full "nose down" to 10.5 degrees "nose up" is from 45 to 87 seconds.

(7) Check that stabilizer motion indicator rotates in airplane "nose up" direction while stabilizer is moving in airplane "nose up" direction and that indicator clicks continuously while stabilizer is in motion.

F. Test Emergency Manual Trim.

(1) Depressurize No. 1 hydraulic system (refer to Chapter 12, SERVICING).

(2) Actuate STAB TRIM SEL switch to OFF position and insert locking pin through pilot's stabilizer trim control lever to lock lever in "neutral" position.

CAUTION: DO NOT OPERATE EMERGENCY MANUAL TRIM UNLESS STABILIZER TRIM LEVER IS LOCKED IN NEUTRAL POSITION.

(3) Remove plate covering stabilizer emergency drive shaft in LH aft lavatory.

(4) Insert drive crank adapter, tool No. 30-43700, into drive shaft. Do not apply sufficient pressure on drive crank adapter to engage drive shaft detent.

(5) Rotate drive crank adapter CW and then CCW. Check that drive crank adapter turns freely in drive shaft and that stabilizer does not move.

(6) Using force measuring device, apply pressure to drive crank adapter until detent in drive shaft is fully engaged.

NOTE: Teeth in drive shaft must be aligned prior to applying inward pressure to drive crank adapter.

(7) Check that force required to engage drive crank adapter with drive shaft detent is 25 (+5.0, -10.0) pounds.

(8) Rotate drive crank mechanism CW or CCW as required to set stabilizer at 0 degrees.

(9) Check that protractor on stabilizer trailing edge reads 0 (±0.5) degrees.

(10) Rotate drive crank mechanism CW until drive crank rotation is limited by hydraulic locking of stabilizer trim control unit. Check that stabilizer moves in airplane nose down direction and that protractor reads 2.25 (±0.50) degrees airplane "nose down".

(11) Attach torque wrench to drive crank adapter.

(12) Using torque wrench, slowly rotate drive crank CCW until drive crank rotation is limited by hydraulic locking of stabilizer trim control unit.

(13) Check that stabilizer moves smoothly in airplane "nose up" direction, that force required to rotate drive crank does not exceed 115 inch-pounds at any point in stabilizer travel, and that stabilizer protractor reads 13.25 (+0.50, -0.75) degrees airplane "nose up".

(14) Using torque wrench, slowly rotate drive crank CW until drive crank rotation is limited by hydraulic locking of stabilizer trim control unit.

(15) Check that stabilizer moves smoothly in airplane "nose down" direction and that force required to rotate drive crank does not exceed 115 inch-pounds at any point in stabilizer travel.

(16) Remove torque wrench from drive crank adapter.

(17) Attach force measuring device to drive crank adapter to measure force required to disengage drive crank adapter from detent.

(18) Using force measuring device, slowly pull drive crank adapter out of drive shaft and check that force required to disengage drive crank adapter from drive shaft is 25 (+5, -10) pounds and that drive crank adapter is free to rotate without moving stabilizer.

(19) Remove force measuring device from drive crank adapter.

(20) Remove drive crank adapter from drive crank shaft.

(21) Install standard drive crank in drive crank shaft and check that drive crank slips easily into drive crank shaft.

(22) Engage drive shaft detent by pushing in on drive crank and check that drive crank engages drive shaft detent smoothly.

(23) Pull out on drive crank to disengage drive shaft detent and remove drive crank from drive shaft.

(24) Install cover plate over drive shaft.

(25) Remove locking pin from pilot's stabilizer trim lever and actuate STAB TRIM SEL switch to HYD position.

G. Test Stabilizer Electric Trim.

(1) Check that MANUAL STAB TRIM circuit breaker is closed and pressurize airplane's No. 1 hydraulic system (refer to Chapter 29, HYDRAULIC POWER).

(2) Actuate and hold STABILIZER TRIM switch on pilot's control wheel in NOSE DOWN position. Stabilizer shall move smoothly in airplane "nose down" position. At full airplane "nose down" position vertical gap between mechanical stops at top of actuator shall be 0.62 (±0.12) inch.

(3) Actuate and hold STABILIZER TRIM switch on pilot's control wheel in NOSE UP position. Stabilizer shall move smoothly in airplane "nose up" direction. At full airplane "nose up" position, vertical gap between mechanical stops at bottom of actuator shall be 0.62 (±0.12) inch.

(4) Release pilot's STABILIZER TRIM switch.

(5) Actuate and hold copilot's STABILIZER TRIM switch in NOSE DOWN position. While stabilizer is moving in airplane "nose down" direction, actuate and hold pilot's STABILIZER TRIM switch in NOSE UP position.

(6) Stabilizer shall move smoothly in "nose down" direction while copilot's switch is held in NOSE DOWN position. Stabilizer shall stop moving when pilot's STABILIZER TRIM switch is moved to NOSE UP position.

(7) Release pilot's STABILIZER TRIM switch. Stabilizer shall move in airplane "nose down" direction.

(8) Release copilot's STABILIZER TRIM switch. Stabilizer shall stop moving.

(9) Actuate and hold copilot's STABILIZER TRIM switch in NOSE UP position until stabilizer reaches approximately 13 degrees airplane "nose up". Stabilizer shall stop moving when copilot's STABILIZER TRIM switch is released.

(10) Install spring scale on pilot's or copilot's stabilizer trim lever. Actuate and hold pilot's STABILIZER TRIM switch in NOSE UP position. While stabilizer is moving in airplane "nose up" direction, use spring scale to return stabilizer trim lever through neutral toward airplane "nose down" position and check that force required to initiate "nose down" motion of stabilizer does not exceed 32 pounds.

(11) Release pilot's STABILIZER TRIM switch.

(12) Actuate and hold pilot's STABILIZER TRIM switch in NOSE DOWN position. While stabilizer is moving in airplane "nose down" direction, use spring scale to return stabilizer trim lever through neutral toward "nose up" position and check that stabilizer stops moving and starts to move in airplane "nose up" direction when stabilizer trim lever has been returned through neutral toward airplane "nose up" position.

(13) Force required to initiate "nose up" motion shall not exceed 32 pounds.

(14) Release pilot's STABILIZER TRIM switch and disconnect spring scale from trim lever.

H. Test Emergency Electric Trim.

(1) Close STAB TRIM CONT EMER circuit breaker and check that STAB TRIM ELEC MOTOR fuses are installed.

(2) Check that STAB TRIM SEL switch on pilots' pedestal is positioned on HYD.

(3) Actuate ELEC STBY STAB CONT switch to NOSE DN position. Stabilizer shall not move.

(4) Actuate ELEC STBY STAB CONT switch to NOSE UP position. Stabilizer shall not move.

(5) Release ELEC STBY STAB CONT switch. Switch shall return to neutral.

(6) Actuate STAB TRIM SEL switch to ELEC STBY position.

(7) Actuate and hold ELEC STBY STAB CONT switch in NOSE UP position until limit switch on EMER STAB motor de-energizes circuit. Stabilizer shall move smoothly in "nose up" direction and vertical gap between actuator lower mechanical stops shall be 0.62 (±0.19) inch.

(8) Actuate ELEC STBY STAB CONT switch to NOSE DN position until limit switch on EMER STAB motor de-energizes circuit. Stabilizer shall move smoothly in "nose down" direction and gap between actuator upper mechanical stops shall be 0.62 (±0.19) inch.

(9) Actuate and hold ELEC STBY STAB CONT switch in NOSE UP position. Using stop watch, check that time required for stabilizer to move from full "nose down" to full "nose up" position is 130 (±20) seconds.

(10) Actuate and hold ELEC STBY STAB CONT switch in NOSE DN position. Using stop watch, check that time required for stabilizer to move from full "nose up" to full "nose down" position is 130 (±20) seconds.

(11) Actuate ELEC STBY STAB CONT switch to NOSE UP position. While stabilizer is moving in airplane "nose up" direction, release ELEC STBY STAB CONT switch and check that switch returns to neutral and that stabilizer stops moving.

(12) Actuate ELEC STBY STAB CONT switch to NOSE DN position. While stabilizer is moving in airplane "nose down" direction, release ELEC STBY STAB CONT switch and check that switch returns to neutral and that stabilizer stops moving.

(13) Actuate STAB TRIM SEL switch to OFF position and check that actuation of neither ELEC STBY STAB CONT nor STABILIZER TRIM switch results in movement of the stabilizer.

(14) Actuate STAB TRIM SEL switch to HYD position.

I. Test Horizontal Stabilizer Electrical Trim Rates.

(1) Close MANUAL STAB TRIM, FLAP ASYM CONT, and STAB TRIM RATE CONT circuit breakers and check that FLAP PWR SEL switch is positioned on NORMAL #1.

(2) Actuate flaps to "full up" position.

CAUTION: DO NOT OPERATE FLAPS WHEN BOTH HYDRAULIC SYSTEMS ARE PRESSURIZED UNLESS ELECTRICAL POWER IS APPLIED TO THE AIRPLANE AND THE "FLAP ASYM CONT" CIRCUIT BREAKER IS CLOSED.

(3) Starting with stabilizer in full "nose up" position, actuate and hold pilot's STABILIZER TRIM switch in NOSE DOWN position until stabilizer reaches full airplane "nose down" position. Using stop watch, check that time required for stabilizer to move from full "nose up" to 0-degree position is from 45 to 65 seconds.

(4) Release pilot's STABILIZER TRIM switch.

CONVAIR MODEL 30

MAINTENANCE MANUAL

TEMPORARY REVISION NO. 27-55.

Insert facing 27-6-0, Page 217, dated Feb. 15/63 (or subsequent).

This temporary revision is applicable to Group I airplanes (refer to Manual INTRODUCTION for explanation of group designations).

For Group II airplanes use the information on 27-6-0, Page 217.

Page 217, delete step (9) and substitute the following:

(9) Move flap control lever to 10° detent. Slats and leading edge flaps will move to extended position, low-rate stop shall disengage, and trim levers shall be free to move forward to high-rate stop.

(5) Starting with stabilizer in full "nose down" position, actuate and hold pilot's STABILIZER TRIM switch in NOSE UP position until stabilizer reaches full airplane "nose up" position. Using stop watch, check that time required for stabilizer to move from full "nose down" to 10.5-degree "nose up" position is from 45 to 65 seconds.

(6) Release pilot's STABILIZER TRIM switch.

(7) Actuate STAB TRIM SEL switch to OFF position.

(8) Move either stabilizer trim lever forward until it contacts low rate stop. Maintain trim lever in this position with light forward pressure.

(9) Move flap control lever to 10-degree detent. Wing leading edge flaps will move to extended position, low-rate stop shall disengage, and trim levers shall be free to move forward to high-rate stop.

(10) Allow stabilizer trim levers to return to NEUTRAL position.

(11) Actuate STAB TRIM SEL switch to HYD position.

(12) Starting with stabilizer in full airplane "nose up" position, actuate and hold pilot's STABILIZER TRIM switch in NOSE DOWN position. Using stop watch, check that time required for stabilizer to move from full airplane "nose up" to 0-degree position is from 25 to 29 seconds.

(13) Release pilot's STABILIZER TRIM switch.

(14) Starting with stabilizer in full "nose down" position, actuate and hold pilot's STABILIZER TRIM switch in NOSE UP position. Using stop watch, check that time required for stabilizer to move from full "nose down" to 10.5 degrees "nose up" is from 25 to 29 seconds.

NOTE: The stabilizer trim "high rate" is approximately twice that of stabilizer trim "low rate".

(15) Starting with stabilizer in full "nose up" position, actuate and hold pilot's stabilizer trim lever full forward until stabilizer reaches full "nose down" position.

(16) Using stop watch, check that time required for stabilizer to move from full "nose up" to 0 degrees is 25 to 34 seconds.

(17) Starting with stabilizer in full "nose down" position, actuate and hold pilot's stabilizer trim lever full aft until stabilizer reaches full "nose up".

(18) Using stop watch, check that time required for stabilizer to move from full "nose down" to 10.5 degrees "nose up" is 25 to 34 seconds.

(19) Return flap control lever to 0° detent and allow flaps to move to "full up" position.

(20) Actuate and hold pilot's STABILIZER TRIM switch in NOSE DOWN position until stabilizer returns to 0-degree position.

(21) Actuate and hold pilot's STABILIZER TRIM switch in NOSE UP position. While stabilizer is moving, actuate flap control lever to 10° detent.

(22) At 3.0 (±2.0) degrees of flap deflection, trim levers on pilots' control pedestal should momentarily return to neutral while stabilizer rate change occurs.

(23) Release pilot's STABILIZER TRIM switch; return flap control lever to 0° detent and allow flaps to move to "full up" position.

J. Test Warning Horn.

(1) Check that speed brake handle is in STOWED position.

(2) Check that LG CONT handle is in DOWN position and all landing gears are down and locked.

(3) Check that all power levers are in IDLE position.

(4) Check that RH LG GROUND SAFETY, LG HAND SOLENOID, and WARN HORN circuit breakers are closed.

(5) Actuate flap control lever to 10° or 27° detent and allow flaps to extend to position selected.

(6) Move stabilizer trim lever forward and allow stabilizer to move to full "nose down" position.

(7) Advance power levers No. 1 and 2 to TAKEOFF position. Warning horn shall sound "one second on - one second off".

(8) Retard power levers to IDLE position. Warning horn shall cease sounding.

(9) Repeat steps (7) and (8) substituting power levers No. 1 and 3, No. 1 and 4, No. 2 and 3, No. 2 and 4, and No. 3 and 4 for power levers No. 1 and 2.

(10) Advance any two power levers to TAKEOFF position. Warning horn shall sound "one second on - one second off".

(11) Deleted.

CONVAIR MODEL 30

MAINTENANCE MANUAL

TEMPORARY REVISION NO. 27-56.

Insert facing 27-6-0, Page 218, dated Feb. 15/63 (or subsequent).

The instructions in this temporary revision are to be used for airplanes not modified per Service Bulletin No. 27-11.

For airplanes that have been modified per Service Bulletin No. 27-11, use the instructions on 27-6-0, Page 218.

Retain this temporary revision in your manual until all applicable airplanes have been modified per noted service bulletin.

Page 218, delete steps I.(20) through I.(23).

CONVAIR MODEL 30

MAINTENANCE MANUAL

TEMPORARY REVISION NO. 27-75.

Insert Tabing 27-6-0, Page 216, dated Feb. 15/63 (or subsequent).

The instructions in this temporary revision are to be used for airplanes not modified per Service Bulletin No. 27-11.

For airplanes that have been modified per Service Bulletin No. 27-11, use the instructions on 27-6-C, Page 216.

Retain this temporary revision in your manual until all applicable airplanes have been modified per noted service bulletin.

Page 216, delete steps 1.(20) through 1.(23).

Feb. 15/63
AB

27-6-0
Sheet 1 of 1

(12) Adjust position of warning horn switch so that it is closed by warning horn cam except when stabilizer is positioned between 0.75 (+0.5, -0.0) "trailing edge down" and 7.0 (+0.5, -0.0) degrees "trailing edge up".

(13) Open RH LG GROUND SAFETY circuit breaker. Warning horn shall cease sounding.

K. Conclusion.

(1) When all tests are satisfactory, return airplane to normal configuration.

4. Adjustment/Test - Tuck Compensator System Functional Test

A. Equipment Required.

(1) Pitot/static test stand with adapter for connecting test stand to static ports on side of airplane. Test stand must be capable of simulating an airspeed of 450 knots and an altitude of 35,000 feet.

(2) External source of hydraulic power.

(3) External source of electrical power.

(4) Stop watch.

B. Preparation.

(1) Connect static pressure line from pitot/static test stand to AUX EQUIP static system and to copilot's static system at RH static system pickup ports on forward RH side of fuselage.

NOTE: Do not disconnect system tubing.

(2) Seal LH static system pickup port on forward LH side of fuselage.

(3) Connect pitot pressure line from pitot/static test stand to copilot's pitot system probe on forward RH side of fuselage.

(4) Connect external source of electrical power and close FLAP ASYM CONT circuit breaker on main circuit breaker panel (refer to Chapter 24, ELECTRICAL POWER).

(5) Check that setting of flap control lever corresponds roughly with position of flaps and that FLAP PWR SELECT switch is positioned on NORMAL #1.

(6) Connect external source of hydraulic power and pressurize both hydraulic systems (refer to Chapter 29, HYDRAULIC POWER).

C. Check System Power Fail Monitor.

(1) Close SPEED STABILITY AC, SPEED STABILITY DC, and SPEED STAB FAIL LT circuit breakers on main circuit breaker panel.

(2) Open SPEED STABILITY AC circuit breaker and check that SPEED STAB FAIL warning light on pilots' center instrument panel illuminates.

(3) Close SPEED STABILITY AC circuit breaker and check that SPEED STAB FAIL warning light extinguishes.

(4) Open SPEED STABILITY DC circuit breaker and check that SPEED STAB FAIL warning light illuminates.

(5) Close SPEED STABILITY DC circuit breaker and check that SPEED STAB FAIL warning light extinguishes.

D. System Operation Functional Test.

CAUTION: DURING FOLLOWING TESTS, DO NOT ALLOW STABILIZER TO EXCEED RANGE OF 1 DEGREE "NOSE DOWN" TO 13 DEGREES "NOSE UP". MONITOR STABILIZER POSITION INDICATOR TO AVOID EXCESSIVE STABILIZER TRAVEL.

(1) Check that STAB TRIM SEL switch on pilot's aft pedestal is positioned on HYD.

(2) Close MANUAL STAB TRIM and STAB POS IND circuit breakers on main circuit breaker panel.

(3) Actuate and hold pilot's or copilot's STABILIZER TRIM switch on control wheel to either NOSE DOWN or NOSE UP as appropriate until distance between stabilizer actuator upper stops is 3.0 inches This distance corresponds with a stabilizer position indicator reading of approximately 0.50 degree "nose down".

(4) Rotate SPEED STAB TEST switch on pilot's instrument panel to NOSE DOWN position and check that stabilizer does not move.

(5) Release SPEED STAB TEST switch and check that switch returns to OFF position.

(6) Rotate and hold SPEED STAB TEST switch in NOSE UP position and check that stabilizer travels 2.31 (±0.40) degrees in "nose up" direction in 19 (±7.0) seconds.

NOTE: Stabilizer angular travel of 2.31 (±0.40) degrees is equivalent to actuator acme nut linear travel of 3.50 (±0.65) inches.

(7) Allow SPEED STAB TEST switch to return to OFF position and check that linear travel of acme nut is less than 1.50 inches.

(8) Retrim stabilizer so that gap between stabilizer actuator upper stops is 3.0 inches.

(9) Repeat step (6).

(10) Rotate and hold SPEED STAB TEST switch in NOSE DOWN position and check that stabilizer travels 2.31 (±0.40) degrees in "nose down" direction in 19 (±7.0) seconds.

(11) Allow SPEED STAB TEST switch to return to OFF position and check that stabilizer does not move.

E. Mach Command Output Functional Test.

CAUTION: WHEN APPLYING OR RELEASING STATIC PRESSURES, DO NOT EXCEED A RATE OF CLIMB OF 6000 FEET PER MINUTE. WHEN VARYING PRESSURES, ALWAYS KEEP PITOT ABSOLUTE PRESSURES HIGHER THAN, OR EQUAL TO, STATIC ABSOLUTE PRESSURES.

(1) Using pilot's or copilot's STABILIZER TRIM switch, adjust stabilizer so that distance between stabilizer actuator upper stops is 3.0 inches.

(2) Slowly apply static pressure of 8.8 inches Hg absolute while maintaining a pitot differential pressure of 3.0 inches Hg.

(3) After pressures have stabilized, slowly bring pitot pressure toward 12.20 inches Hg absolute and check that no pulse occurs below 12.20 inches Hg absolute, that first pulse occurs before a pitot pressure of 12.56 inches Hg absolute is reached, and that leading edge of stabilizer moves downward.

(4) Slowly bring pitot pressure to 14.24 inches Hg absolute and count pulses. There shall be 19 (±2.0) pulses including pulses which occurred in step (3).

(5) Slowly bring pitot pressure to 16.20 inches Hg absolute and continue to count pulses. The total number of pulses, including those that occurred in steps (3) and (4), shall be 57 (±3.0).

(6) Check that total stabilizer travel is 5.25 (±0.27) inches measured at actuator screw jack.

(7) Slowly reduce pitot pressure to 12.20 inches Hg absolute and count the number of pulses. There shall be 57 (±3.0) pulses, total stabilizer travel measured at screw jack shall be 5.25 (±0.27) inches, and stabilizer leading edge shall move upward. Stabilizer travel shall be the same as in step (6) within specified tolerance.

(8) Slowly bring pitot and static pressures to atmospheric.

F. Conclusion.

When all tests are satisfactory, return airplane to normal configuration.

STABILIZER TRIM HYDRAULIC CONTROL VALVE - MAINTENANCE PRACTICES

1. Removal/Installation - Stabilizer Trim Hydraulic Control Valve (see Figure 201)

   A. Equipment Required.

      (1) Stand suitable for reaching forward tail cone access door.

      (2) Receptacle for draining disconnected hydraulic lines.

      (3) Index pins 22-J107-1 and -2.

   B. Remove Stabilizer Trim Hydraulic Control Valve.

      (1) Open AC and DC SPEED STABILITY, MANUAL STAB TRIM, STAB TRIM CONT EMER, AUTO PLT TRIM RATE LIMIT (MECH), and AUTO PLT TRIM & TRIM RATE LIMIT (HYD) circuit breakers on main circuit breaker panel and depressurize No. 1 hydraulic system (refer to Chapter 12, SERVICING).

      (2) Gain access to tail cone through forward access door.

      (3) Disconnect electrical connector from RH side of valve.

      (4) Disconnect and remove two hydraulic lines between top of valve and actuator hydraulic motor.

      (5) Disconnect hydraulic pressure line from front of valve and hydraulic return line from top of valve.

      (6) Detach connecting link from control valve arm.

      (7) Remove three mounting bolts and remove control valve.

   C. Install Stabilizer Trim Hydraulic Control Valve.

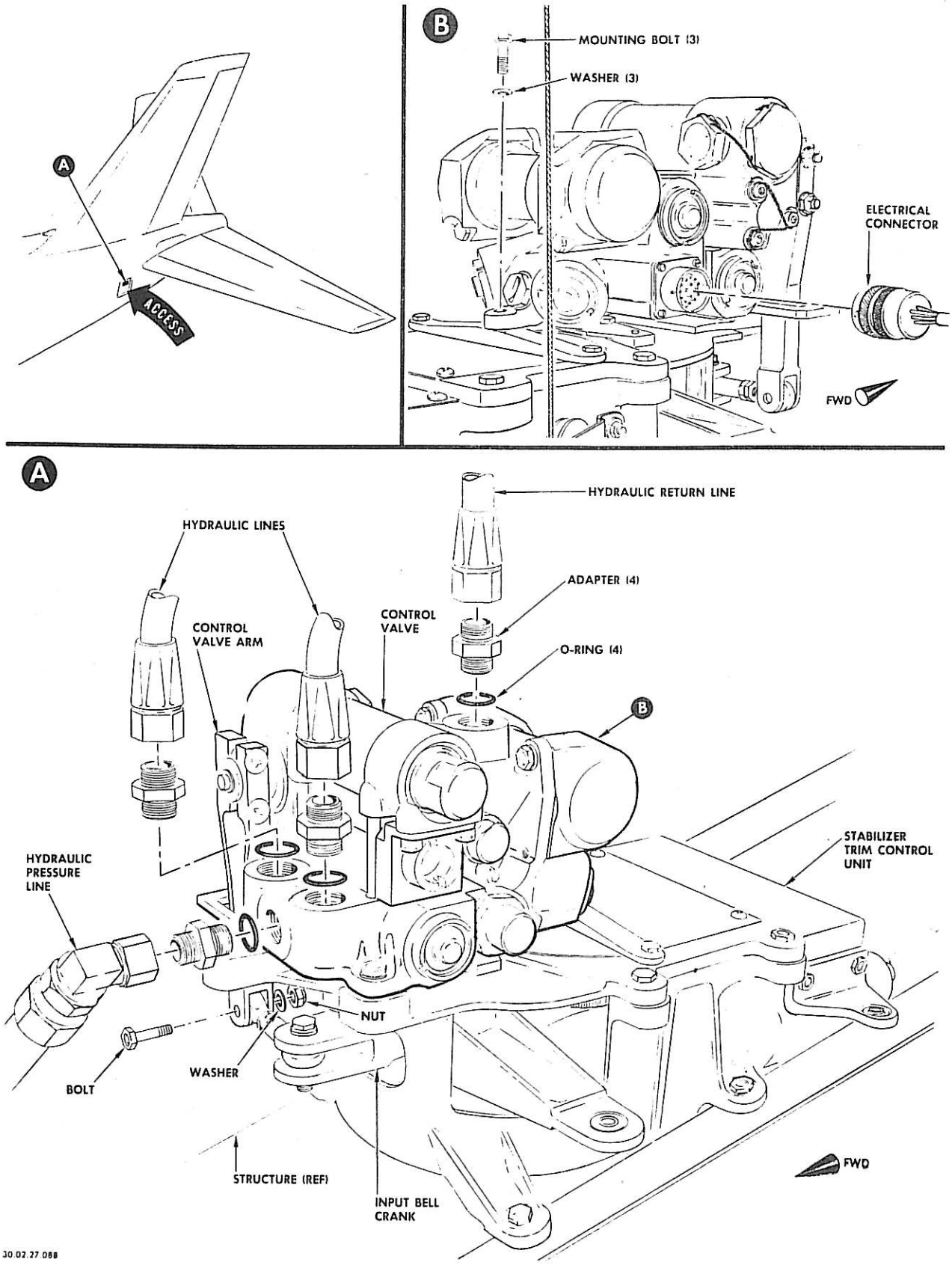
      (1) Position control valve on stabilizer trim control unit and install three mounting bolts.

      (2) Connect hydraulic lines disconnected when valve was removed.

      (3) Install electrical connector on RH side of control valve.

      (4) Install index pin 22-J107-2 in stabilizer trim control lever on pilots' pedestal and index pin 22-J107-1 in control valve input arm.

      (5) Adjust length of connecting link as necessary to distance between rigged control valve input arm and positioned control unit input bell crank. Install connecting link on control valve input arm.


A
ACCESS
B
MOUNTING BOLT (3)
WASHER (3)
ELECTRICAL CONNECTOR
FWD
A
HYDRAULIC RETURN LINE
HYDRAULIC LINES
ADAPTER (4)
CONTROL VALVE ARM
CONTROL VALVE
O-RING (4)
B
STABILIZER TRIM CONTROL UNIT
HYDRAULIC PRESSURE LINE
NUT
WASHER
BOLT
STRUCTURE (REF)
INPUT BELL CRANK
FWD
30.02.27.088

(6) Remove index pins from stabilizer trim control lever and control valve input arm.

(7) Bleed stabilizer trim hydraulic system (refer to Adjustment/Test - Stabilizer Trim System Bleeding Procedure).

(8) Test stabilizer trim system (refer to 27-6-0, Adjustment/Test - Stabilizer Trim System Functional Test).

NOTE: If the stabilizer trim hydraulic control valve only has been replaced and no other rigging or adjustment has been changed, check stabilizer trim system operation per 27-6-0, steps 3.E.(1) through 3.E.(3), 3.E.(5), 3.E.(6), 3.G.(1) through 3.G.(3) and paragraph 4.D.

2. Removal/Installation - Stabilizer Trim Control Unit and Control Valve Assembly (see Figure 202)

A. Equipment Required.

(1) Stand suitable for reaching tail cone forward access door.

(2) Index pins 22-J107-1 and -2.

(3) Dial indicator, telescoping gage, or shop-fabricated centering tool for centering control unit input bell crank.

B. Remove Stabilizer Trim Control Unit and Control Valve Assembly.

(1) Open AC and DC SPEED STABILITY, MANUAL STAB TRIM, STAB TRIM CONT EMER, AUTO PLT TRIM RATE LIMIT (MECH), and AUTO PLT TRIM & TRIM RATE LIMIT (HYD) circuit breakers on main circuit breaker panel.

(2) Depressurize No. 1 hydraulic system (refer to Chapter 12, SERVICING).

(3) Gain access to rear baggage compartment and open zippered access panel in fabric curtain in rear of compartment.

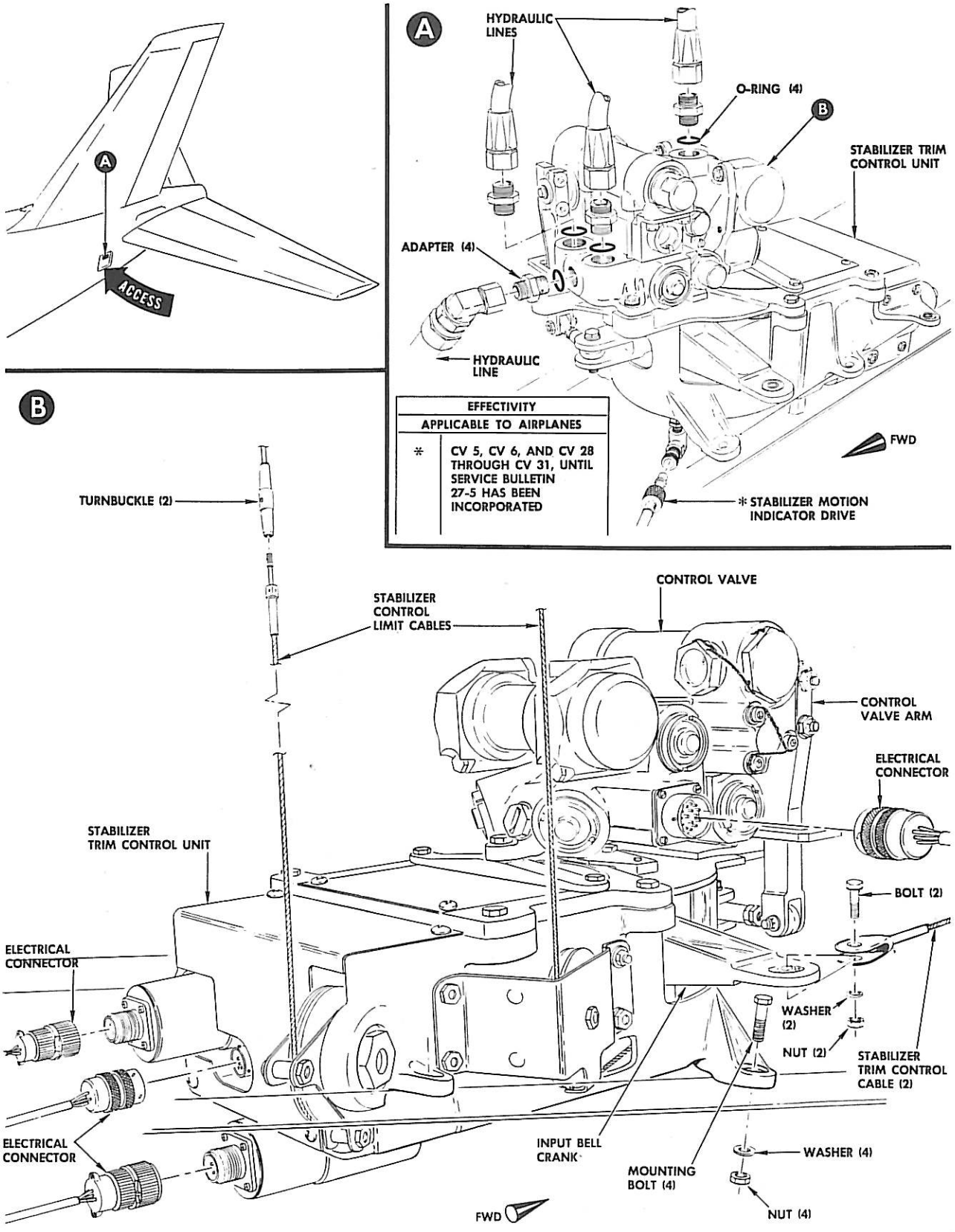
(4) Loosen turnbuckles on stabilizer trim control cables near fuselage centerline and just above and slightly aft of cabin pressure regulator.

(5) Gain access to tail cone through forward access door.

(6) Disconnect stabilizer trim control cables from control unit input bell crank.

(7) Disconnect electrical connector from control valve and three electrical connectors from control unit.

(8) Loosen turnbuckles in lower loop of stabilizer control limit cables and disconnect cables.


A
ACCESS
HYDRAULIC LINES
O-RING (4)
B
STABILIZER TRIM CONTROL UNIT
ADAPTER (4)
HYDRAULIC LINE
EFFECTIVITY
APPLICABLE TO AIRPLANES
* CV 5, CV 6, AND CV 28 THROUGH CV 31, UNTIL SERVICE BULLETIN 27-5 HAS BEEN INCORPORATED
FWD
* STABILIZER MOTION INDICATOR DRIVE
B
TURNBUCKLE (2)
CONTROL VALVE
STABILIZER CONTROL LIMIT CABLES
CONTROL VALVE ARM
ELECTRICAL CONNECTOR
STABILIZER TRIM CONTROL UNIT
BOLT (2)
ELECTRICAL CONNECTOR
WASHER (2)
NUT (2)
STABILIZER TRIM CONTROL CABLE (2)
ELECTRICAL CONNECTOR
INPUT BELL CRANK
WASHER (4)
MOUNTING BOLT (4)
FWD
NUT (4)

30.02.27.090

(9) Disconnect hydraulic lines from stabilizer trim hydraulic control valve and wipe up any spilled hydraulic fluid.

(10) *Disconnect stabilizer motion indicator drive from beneath trim control unit.

(11) Remove four mounting bolts and remove control unit and valve assembly.

C. Assemble and Install Stabilizer Trim Control Unit and Control Valve Assembly.

NOTE: The stabilizer trim control unit and stabilizer trim centering spring must be assembled prior to installation of the control unit. The control valve should also be installed at this time. The control unit is bench rigged prior to installation.

(1) Attach forked end of centering spring cartridge to lug on left side of control unit. Loosen check nut securing forked end to centering spring shaft.

(2) Using dial indicator, telescoping gage, or shop-fabricated centering tool, center input bell crank. Adjust forked end of centering spring shaft as necessary and attach to positioned input bell crank. Tighten check nut.

(3) Check center adjustment of input bell crank: Make minor adjustment at forked end of centering spring shaft, if necessary.

(4) Position control valve on stabilizer trim control unit and install three mounting bolts.

(5) Insert index pin 22-J107-1 in control valve input arm.

(6) Adjust connecting link to length between rigged input arm and positioned input bell crank and install connecting link on control valve input arm.

(7) Position stabilizer trim control unit and control valve assembly on floor beams and install four mounting bolts.

(8) Attach stabilizer trim control cables to control unit input bell crank.

(9) Tighten control cable turnbuckles in rear of aft baggage compartment until cable tension is 85 (±10) pounds at 70 degrees F (21 degrees C). Increase or decrease specified cable tension 0.25 pound for each degree F (0.50 pound for each degree C) increase or decrease respectively in free air temperature.

*Applicable to airplanes CV5, CV6, and CV28 through CV31 until Service Bulletin 27-5 has been incorporated.

(10) Alternately loosen and tighten opposing control cable turnbuckles until index pin 22-J107-2 will pass through stabilizer trim control lever on pilot's pedestal.

(11) Remove index pin from control valve input arm.

(12)*Connect stabilizer motion indicator drive to drive shaft beneath trim control unit.

(13) Connect stabilizer control limit cables to turnbuckles and adjust tension of control limit cables (refer to 27-6-0, Adjustment/Test - Adjust Horizontal Stabilizer Trim System, steps 1.D.(6) through 1.D.(21).

(14) Connect hydraulic lines to trim hydraulic control valve and hydraulic motor.

(15) Install electrical connectors on control valve and control unit.

(16) Adjust stabilizer trim control unit stops (refer to 27-6-0, Adjustment/Test - Adjust Horizontal Stabilizer Trim System, paragraph I.E.).

(17) Bleed No. 1 hydraulic system (refer to 27-6-0, Adjustment/Test - Stabilizer Trim System Bleeding Procedure).

(18) Make final adjustment to autopilot stop per paragraph D.

(19) Test stabilizer trim system (refer to 27-6-0, Adjustment/Test - Stabilizer Trim System Functional Test, Adjustment/Test Tuck Compensator Functional Test, and Chapter 22, AUTOPILOT).

NOTE: If the stabilizer control unit and control valve assembly only has been replaced and no other rigging or adjustment has been changed, check stabilizer trim system operation per 27-6-0, paragraphs 3.D., 3.E., steps 3.G.(1) through 3.G.(3), paragraphs 3.I. and 4.D. and Chapter 22, AUTOPILOT. (Refer to Chapter 22, AUTOPILOT, for autopilot trim rate check.)

D. Adjust Autopilot Stop.

(1) Pressurize No. 1 hydraulic system (refer to Chapter 29, HYDRAULIC POWER).

(2) Actuate autopilot controller trim switch to move stabilizer in the nose up, and then the nose down direction. Operate for 30 seconds in each direction. Measure distance nut on screwjack has traveled; travel shall be 3.50 (±0.20) inches in either direction.

*Applicable to airplanes CV5, CV6, and CV28 through CV31 until Service Bulletin 27-5 has been incorporated.

(3) If rate of stabilizer travel is not within tolerance, rotate each autopilot cam section inboard to decrease travel, or outboard to increase travel. Each 1/4 turn of cam is equivalent to approximately 0.25 inch of travel.

(4) With flap position solenoid energized and autopilot solenoid de-energized, rotate input bell crank in counterclockwise direction. Observe autopilot override spring as roller on input bell crank passes high point on autopilot rate cam.

(5) If spring deflects, remove cotter pin and adjust autopilot solenoid cap until spring no longer deflects and no force increase is felt when roller passes over high point on cam.

(6) Repeat steps (2) through (5).

(7) Secure cam section with retainer, screw, and safety wire; secure cam shaft to cam and solenoid adjuster cap to solenoid with cotter pins.

HYDRAULIC TRIM MOTOR - MAINTENANCE PRACTICES

1. Removal/Installation Hydraulic Trim Motor (see Figure 201)

A. Equipment Required.

(1) Stand suitable for reaching tail cone side access door.

(2) Receptacle for draining hydraulic lines.

B. Remove Hydraulic Trim Motor.

(1) Open tail cone side access door.

(2) Disconnect and remove three hydraulic lines from hydraulic trim motor. Drain hydraulic lines in receptacle and cap and tag lines for installation.

(3) Remove four bolts attaching hydraulic trim motor to screw jack lower housing.

(4) Slide splined motor shaft out of serrated coupling on worm gear and remove hydraulic motor.

C. Install Hydraulic Trim Motor.

(1) Position hydraulic motor and insert splined motor shaft in serrated worm gear coupling.

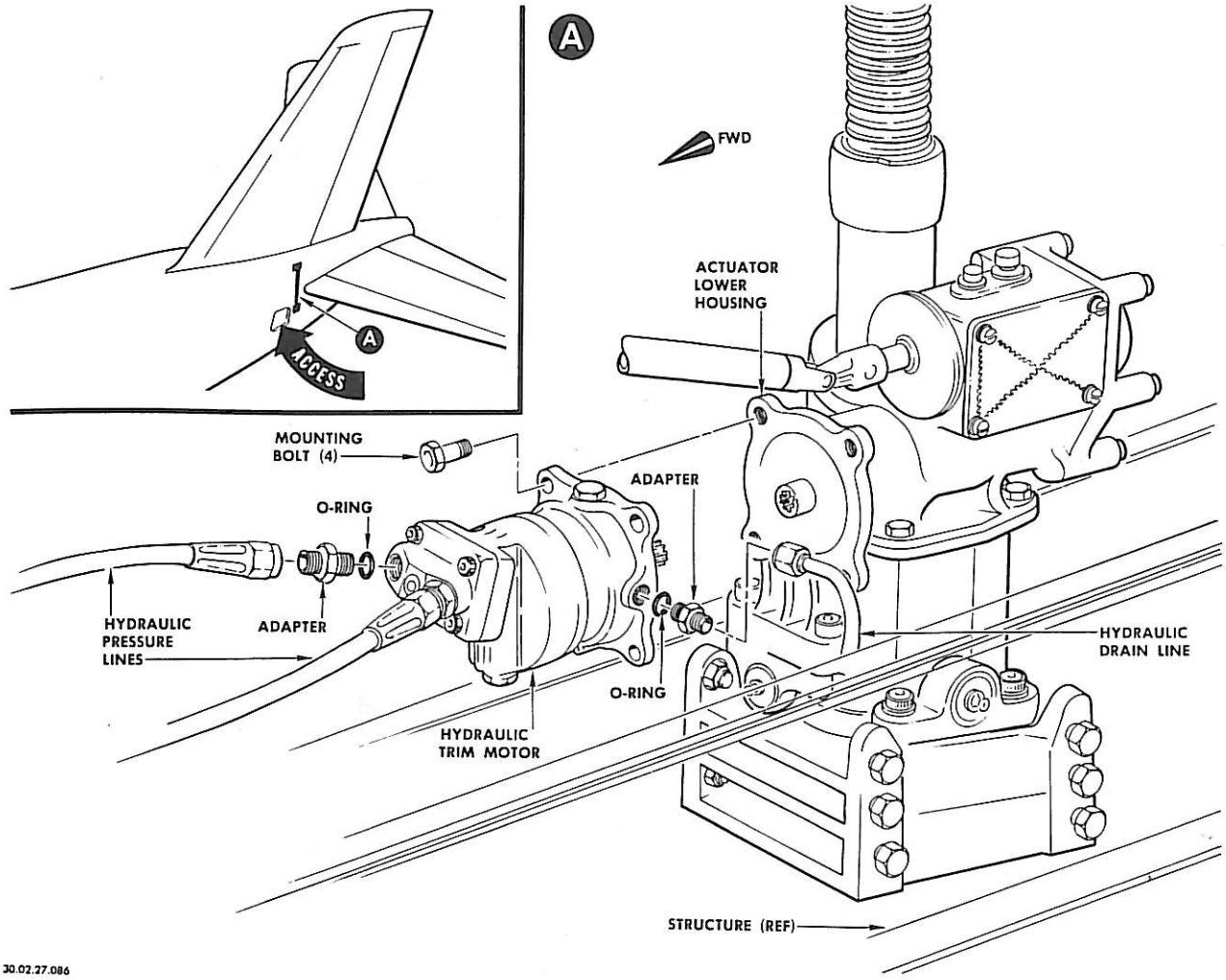
(2) Install four bolts attaching trim motor to screw jack lower housing.

(3) Install hydraulic lines between motor and flexible lines. Bleed hydraulic lines (refer to 27-6-0, Adjustment/Test Horizontal Stabilizer Bleeding Procedure).

(4) Check stabilizer trim system operation (refer to 27-6-0, Adjustment/Test Stabilizer Trim System Functional Test).

NOTE: If the hydraulic trim motor only has been replaced and no other rigging or adjustment has been changed, check stabilizer trim system operation per 27-6-0, steps 3.E.(1) through 3.E.(6).

(5) Clean up spilled hydraulic fluid and close tail cone side access door.


A
ACCESS
A
FWD
ACTUATOR LOWER HOUSING
MOUNTING BOLT (4)
ADAPTER
O-RING
HYDRAULIC PRESSURE LINES
ADAPTER
HYDRAULIC DRAIN LINE
O-RING
HYDRAULIC TRIM MOTOR
STRUCTURE (REF)
30.02.27.086

HORIZONTAL STABILIZER ACTUATOR - MAINTENANCE PRACTICES

1. Removal/Installation - Horizontal Stabilizer Actuator (see Figure 201)

A. Equipment Required.

(1) Stand suitable for reaching forward tail cone access door.

(2) Receptacle for draining disconnected hydraulic lines.

(3) Torque wrench.

(4) Wrench No. TUWR22J152 for turning emergency drive spline.

(5) Hand jack to support leading edge of torque box.

(6) Index pin 22-J107-1.

B. Remove Horizontal Stabilizer Actuator.

(1) Open AC and DC SPEED STABILITY, MANUAL STAB TRIM, STAB TRIM CONT EMER, AUTO PLT TRIM RATE LIMIT (MECH), and AUTO PLT TRIM & TRIM RATE LIMIT (HYD) circuit breakers on main circuit breaker panel.

(2) Gain access to tail cone through forward access door.

(3) Remove stabilizer trim control assembly (refer to Removal/ Installation - Stabilizer Trim Control Unit and Control Valve Assembly.

NOTE: It may be possible to remove stabilizer actuator without removing stabilizer trim control assembly. However, due to difficulty of handling actuator in tail cone, it is suggested that control unit be removed to avoid excessive loss of time, probable damage to aircraft components, and possible injury to maintenance personnel.

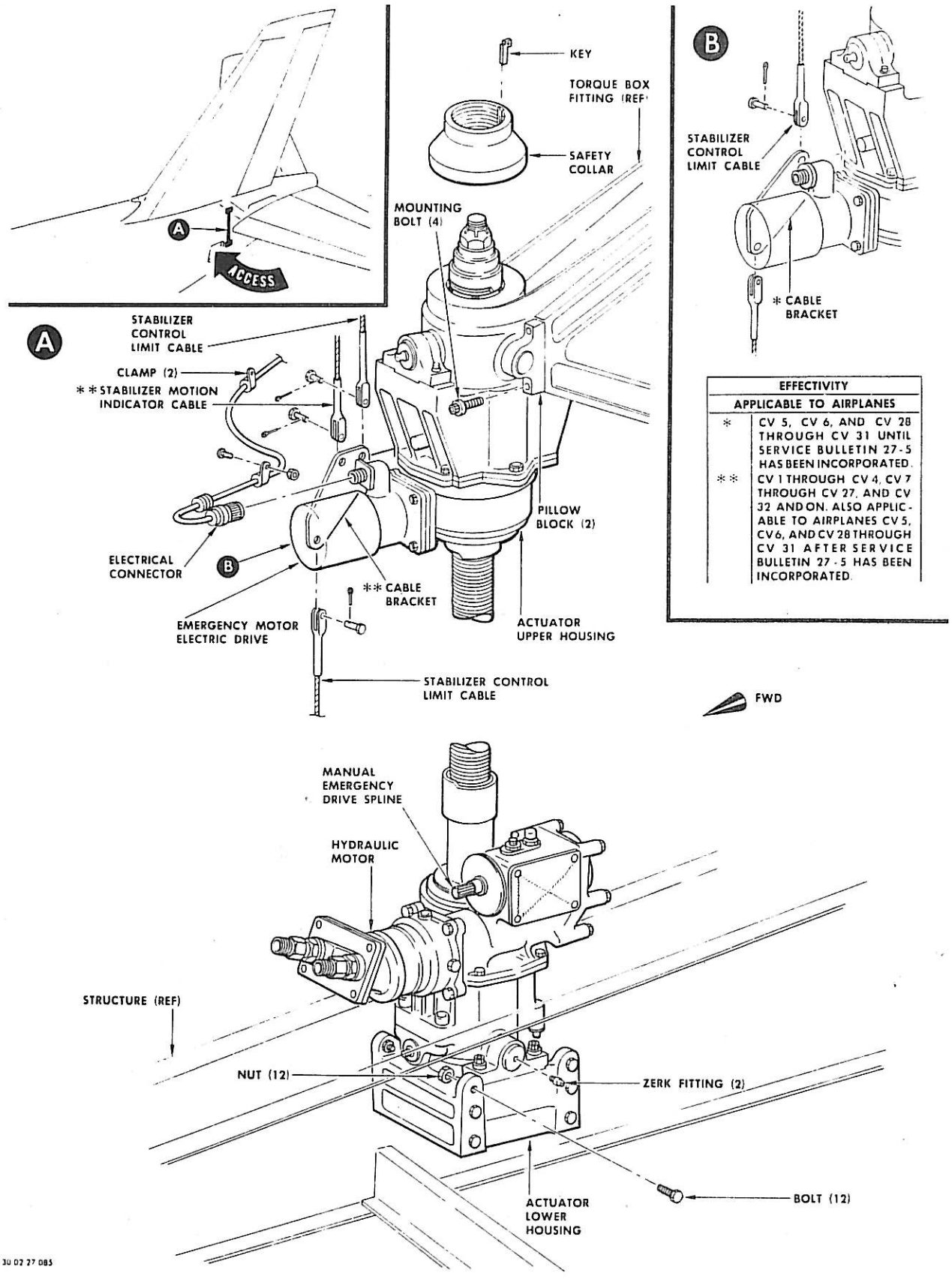
(4) Disconnect electrical connector from emergency electric drive motor and release two clamps supporting electrical wiring.

(5)*Disconnect upper loop of stabilizer control limit cable from cable bracket on actuator upper housing.

(6)**Disconnect upper loop of stabilizer control limit cable and stabilizer motion indicator cable from cable bracket on actuator upper housing.

* Applicable to airplanes CV5, CV6, and CV28 through CV31 until Service Bulletin 27-5 has been incorporated.

** Applicable to airplanes CV1 through CV4, CV7 through CV27, and CV32 through CV37. Also applicable to airplanes CV5, CV6, and CV28 through CV31 after Service Bulletin 27-5 has been incorporated.



Horizontal Stabilizer Trim Actuator
Installation
Figure 201

(7) If stabilizer trim control assembly has not been removed, disconnect hydraulic line from bracket on RH side of actuator lower housing and disconnect manual trim drive shaft. Wipe up any spilled hydraulic fluid.

(8) Remove Zerk fittings from RH and LH ends of lower gimbal pin through holes in floor beams adjacent to lower housing.

(9) Using wrench No. TUWR22J152, rotate emergency drive spline and raise leading edge of stabilizer to full "nose down" position.

(10) Position hand jack between top of torque box and first former aft of torque box leading edge. Protect torque box and former with suitable pads or blocks.

(11) Remove nuts from 12 bolts attaching stabilizer actuator lower housing to structure.

(12) Operate hand jack and lower leading edge of torque box until actuator mounting bolts turn easily. Remove 12 mounting bolts.

NOTE: Leave hand jack in place to keep stabilizer leading edge from moving upward. Stabilizer is approximately 540 pounds tail heavy and would damage structure if allowed to rotate beyond normal travel limits.

(13) Rotate emergency drive spline and raise actuator lower housing clear of structural members in floor of tail cone.

(14) Place wooden support block across structural members beneath actuator lower housing and rotate emergency drive spline to extend actuator until weight of actuator is supported by wooden block.

(15) Remove key from safety collar above actuator upper housing and remove safety collar.

(16) Remove four bolts attaching pillow blocks to fitting on leading edge of torque box. Tag pillow blocks RH and LH and top and bottom.

NOTE: Pillow blocks are fitted individually to torque box fitting and must be replaced in original location and position.

(17) Move bottom of actuator forward and bring top of screw jack down through torque box fitting.

CAUTION: HANDLE ACTUATOR WITH EXTREME CARE TO AVOID DAMAGE TO ACTUATOR, STRUCTURE, OR OTHER PARTS.

(18) Unless actuator is being reinstalled immediately, place additional supports between top of torque box and fuselage former.

C. Install Horizontal Stabilizer Actuator.

(1) Check that leading edge of stabilizer is raised to full "nose down" position.

(2) Using wrench No. TUWR22J152, rotate emergency drive spline and position actuator upper housing near center of screw jack.

(3) If appropriate, remove key from safety collar near upper end of screw jack and remove collar.

(4) Slide upper end of screw jack upward through torque box circular fitting and rest bottom of actuator on wooden support blocks placed across floor beams.

(5) Rotate emergency drive spline and raise actuator upper housing until lateral upper gimbal trunnions are aligned with recesses in torque box fitting.

(6) Install four bolts attaching pillow blocks to torque box fitting. Tighten but do not torque nuts.

(7) Install safety collar. Tighten finger-tight and then back off collar and insert key in third available keyway. Secure key with safety wire.

(8) Rotate emergency drive spline and raise actuator lower housing from support blocks. Remove support blocks.

(9) Rotate emergency drive spline and lower actuator housing between floor beams until hole patterns in beams and housing coincide.

(10) Install 12 mounting bolts (with heads inboard) attaching lower housing to floor beams.

(11) Torque pillow block nuts to 1500 inch-pounds.

(12) Install Zerk fittings on RH and LH ends of lower gimbal pin through holes in floor beams.

(13) Connect hydraulic line to bracket on RH side of actuator lower housing.

(14) Install electrical connector on emergency electric drive motor and install two clamps supporting electrical wiring.

(15) Remove hand jack from top of torque box.

(16) *Connect upper loop of stabilizer control limit cable to cable bracket on actuator upper housing.

(17) **Connect upper loop of stabilizer control limit cable and stabilizer motion indicator cable to cable bracket on actuator upper housing.

(18) Install stabilizer trim control assembly (refer to Removal/Installation - Stabilizer Trim Control Unit and Control Valve Assembly).

(19) Check stabilizer trim system operation (refer to 27-6-0, Adjustment/Test Stabilizer Trim System Functional Test).

NOTE: If the horizontal stabilizer actuator only has been replaced and no other rigging or adjustment has been changed, check stabilizer trim system operation per 27-6-0, paragraph 3.D., 3.E., steps 3.G.(1) through 3.G.(3), 3.H.(7), 3.H.(8), paragraphs 3.I. and 4.D. and Chapter 22, AUTOPILOT. (Refer to Chapter 22, AUTOPILOT, for autopilot trim rate check.)

*Applicable to airplanes CV5, CV6, and CV28 through CV31 until Service Bulletin 27-5 has been incorporated.

**Applicable to airplanes CV1 through CV4, CV7 through CV27, and CV32 through CV37. Also applicable to airplanes CV5, CV6, and CV28 through CV31 after Service Bulletin 27-5 has been incorporated.

EMERGENCY ELECTRIC TRIM MOTOR - MAINTENANCE PRACTICES

1. Removal/Installation Emergency Electric Trim Motor (see Figure 201)

   A. Equipment Required.

      (1) Stand suitable for entrance to tail cone forward access door.

      (2) Suitable container to catch spilled lubricating oil.

      (3) Lubricating oil per Specification MIL-O-6086, Grade L.

   B. Remove Emergency Electric Trim Motor.

      (1) Open SPEED STAB circuit breaker on main circuit breaker panel.

      (2) Open tail cone forward access door.

      (3) Remove clamp attaching wire bundle to connector. Disconnect electrical connector from motor.

      (4) Remove drain plug and hold container under drain hole to catch lubricating oil. Replace plug.

      (5) Remove four motor mounting bolts and pull motor straight out of actuator upper housing to disengage motor shaft splines.

      (6) Make sure that motor gasket is completely removed from motor mounting pad and motor base.

   C. Install Emergency Electric Trim Motor.

      (1) Position motor and new gasket on motor mounting pad, engage splined shaft, and install four motor mounting bolts.

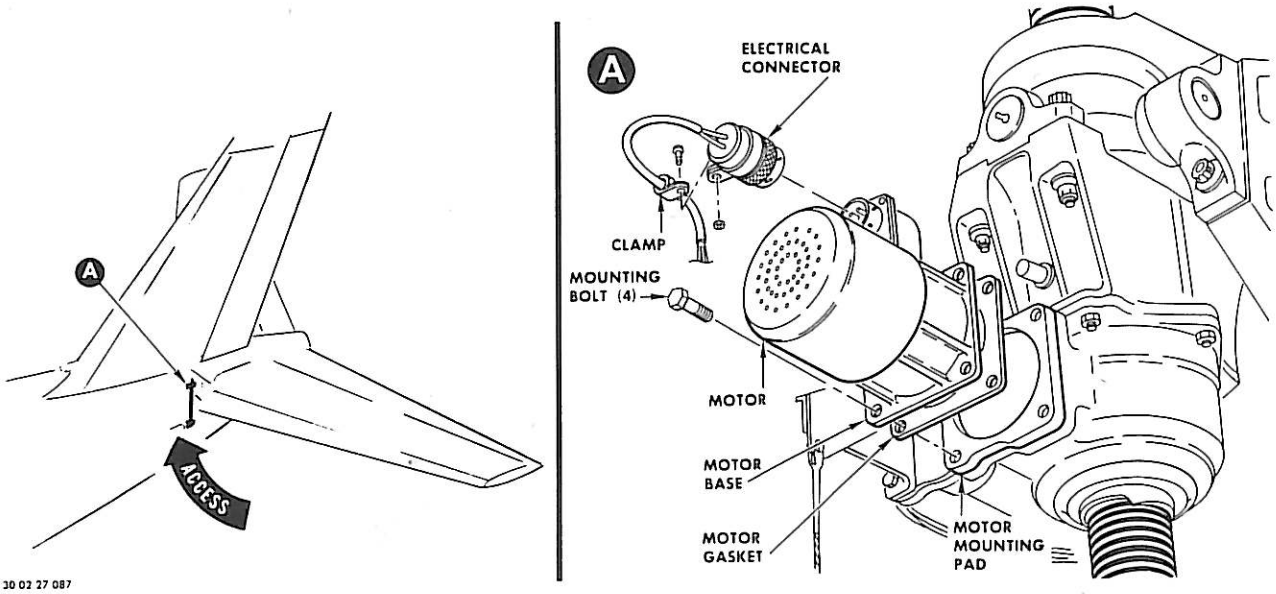
      (2) Connect electrical connector and attach wire mounting clamp to connector.

      (3) Lubricate worm gear with oil, Specification MIL-O-6086 (refer to Chapter 12, SERVICING).

      (4) Test system (refer to 27-6-0, Adjustment/Test Horizontal Stabilizer Trim System Functional Test).

         NOTE: If the emergency electric trim motor only has been replaced and no other rigging or adjustment has been changed, check stabilizer trim system operation per 27-6-0, steps 3.H.(7) and 3.H.(8).

      (5) Close access door and return airplane to normal configuration.


A
ACCESS
30 02 27 087
A
ELECTRICAL CONNECTOR
CLAMP
MOUNTING BOLT (4)
MOTOR
MOTOR BASE
MOTOR GASKET
MOTOR MOUNTING PAD

STABILIZER EMERGENCY MANUAL DRIVE TORQUE TUBE - MAINTENANCE PRACTICES

1. Removal/Installation Stabilizer Emergency Manual Drive Torque Tube (see Figure 201)

   A. Equipment Required - Safety wire (MS 20995C32).

   B. General.

      When performing the following operations, gain access to emergency manual drive torque tube components as follows: gain access to torque tube components located forward of the pressure bulkhead by removing the linen and paper waste containers from cabinets under left aft lavatory wash basin. Gain access to torque tube components located aft of pressure bulkhead (in tail cone) through tail cone forward access door. (Door is at aft left side of fuselage just forward and below horizontal stabilizer.)

   C. Remove Stabilizer Emergency Manual Drive Torque Tube.

      (1) Remove nuts and spacers from taper pins at forward end of universal joint just forward of pressure bulkhead; remove taper pins.

      (2) Pull drive tube forward through drive tube forward and aft bearing housings and remove tube.

      (3) Remove two screws securing aft end of torque tube in tail cone to stabilizer actuator spline drive shaft.

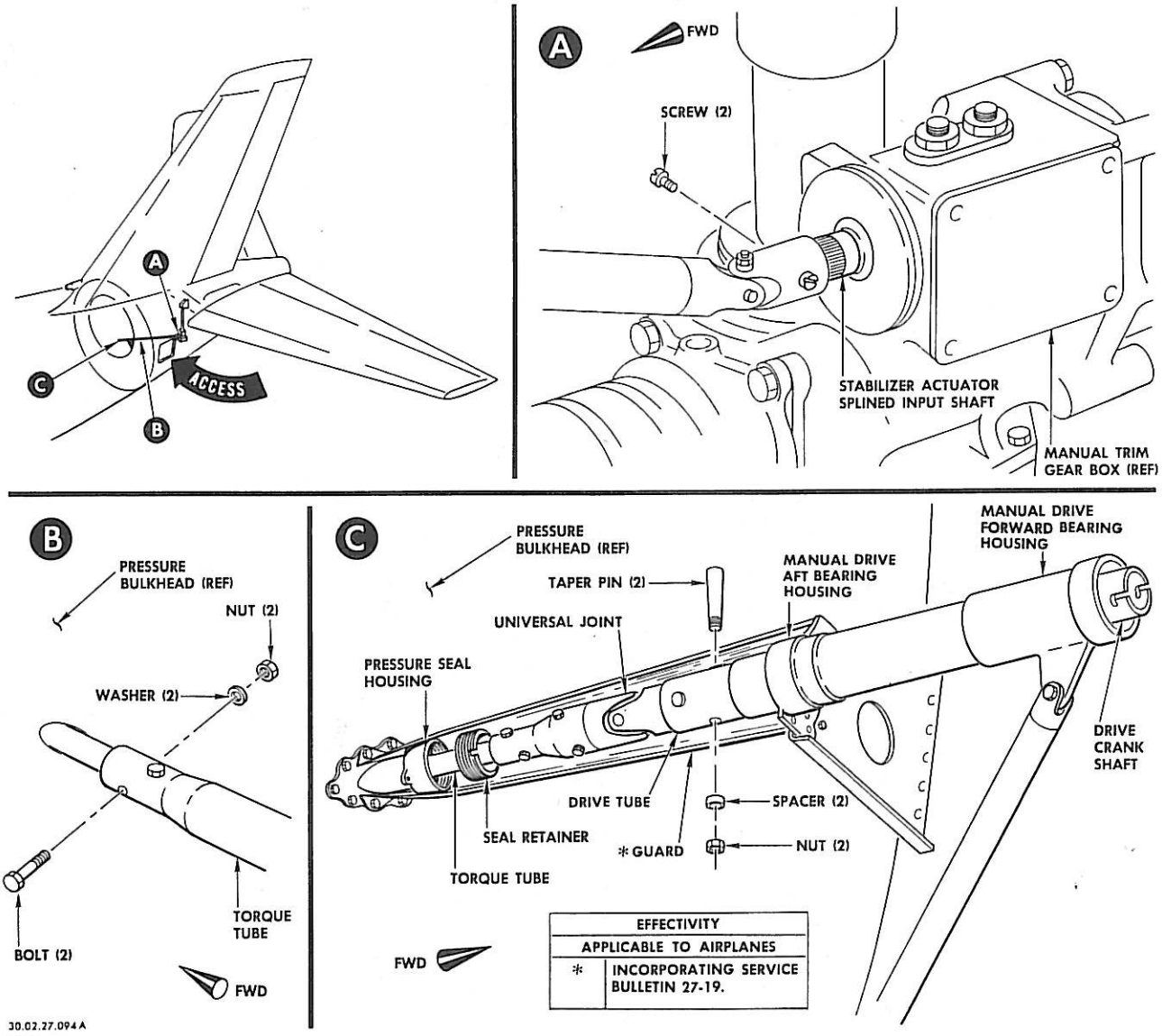
      (4) Remove two bolts securing opposite (forward) end of torque tube in tail cone to torque tube extending through pressure bulkhead. Remove torque tube from tail cone.

      (5) Loosen seal retainer in pressure seal housing on forward side of pressure bulkhead and remove universal joint and attached short section of torque tube. Short section of torque tube extends through pressure seal and pressure bulkhead.

   D. Install Stabilizer Emergency Manual Drive Torque Tube.

      (1) Install short section of torque tube, with pressure seal, seal retainer and universal joint, in pressure seal housing on forward side of pressure bulkhead. Tighten seal retainer until it bottoms in housing, then secure retainer with safety wire.

      (2) Connect torque tube in tail cone to stabilizer actuator splined shaft and section of torque tube extending through pressure bulkhead. Make sure that screws at actuator end of tube engage annular groove in actuator splined shaft. Secure opposite end of torque tube with two bolts and nuts.


A
B
C
ACCESS
FWD
SCREW (2)
STABILIZER ACTUATOR SPLINED INPUT SHAFT
MANUAL TRIM GEAR BOX (REF)
PRESSURE BULKHEAD (REF)
NUT (2)
WASHER (2)
TORQUE TUBE
BOLT (2)
FWD
30.02.27.094 A
PRESSURE BULKHEAD (REF)
TAPER PIN (2)
MANUAL DRIVE AFT BEARING HOUSING
MANUAL DRIVE FORWARD BEARING HOUSING
UNIVERSAL JOINT
PRESSURE SEAL HOUSING
DRIVE CRANK SHAFT
DRIVE TUBE
SPACER (2)
SEAL RETAINER
* GUARD
NUT (2)
TORQUE TUBE
FWD
EFFECTIVITY
APPLICABLE TO AIRPLANES
* INCORPORATING SERVICE BULLETIN 27-19.

(3) Insert drive tube aft through forward and aft bearing housings in aft left lavatory. Secure drive tube to universal joint on short section of torque tube with two taper pins; secure pins with spacers and nuts.

(4) Check stabilizer trim system operation (refer to 27-6-0, Adjustment/Test Stabilizer Trim System Functional Test).

NOTE: If the emergency manual drive torque tube only has been replaced and no other rigging or adjustment has been changed, check stabilizer trim system operation per 27-6-0, Adjustment/Test Stabilizer Trim System Functional Test, paragraph 3.F.

(5) Install linen and paper waste containers in cabinet under wash basin in left aft lavatory.

(6) Close tail cone forward access door.

STABILIZER TRIM HYDRAULIC SHUTOFF VALVE - MAINTENANCE PRACTICES

1. Removal/Installation Stabilizer Trim Hydraulic Shutoff Valve (see Figure 201)

A. Equipment Required.

(1) Stand or ladder suitable for reaching and entering tail cone forward access door.

(2) Drip pan to catch spilled hydraulic fluid.

(3) External source of hydraulic power.

(4) External source of electric power.

B. General.

The stabilizer trim hydraulic shutoff valve is installed in the tail cone. It is the upper one of two valves mounted low on the aft side of the bulkhead opposite the tail cone forward access door.

C. Remove Stabilizer Trim Hydraulic Shutoff Valve.

(1) Open tail cone forward access door.

(2) Depressurize No. 1 hydraulic system (refer to Chapter 12, SERVICING).

(3) Open STAB TRIM CONT EMER circuit breaker on main circuit breaker panel.

(4) Disconnect electrical connector from valve electrical outlet.

(5) Position drip pan beneath valve to catch spilled hydraulic fluid.

(6) Disconnect hydraulic line from each side of valve. Cap lines to prevent entry of foreign materials.

(7) Remove two valve mounting bolts and remove valve from mounting bracket.

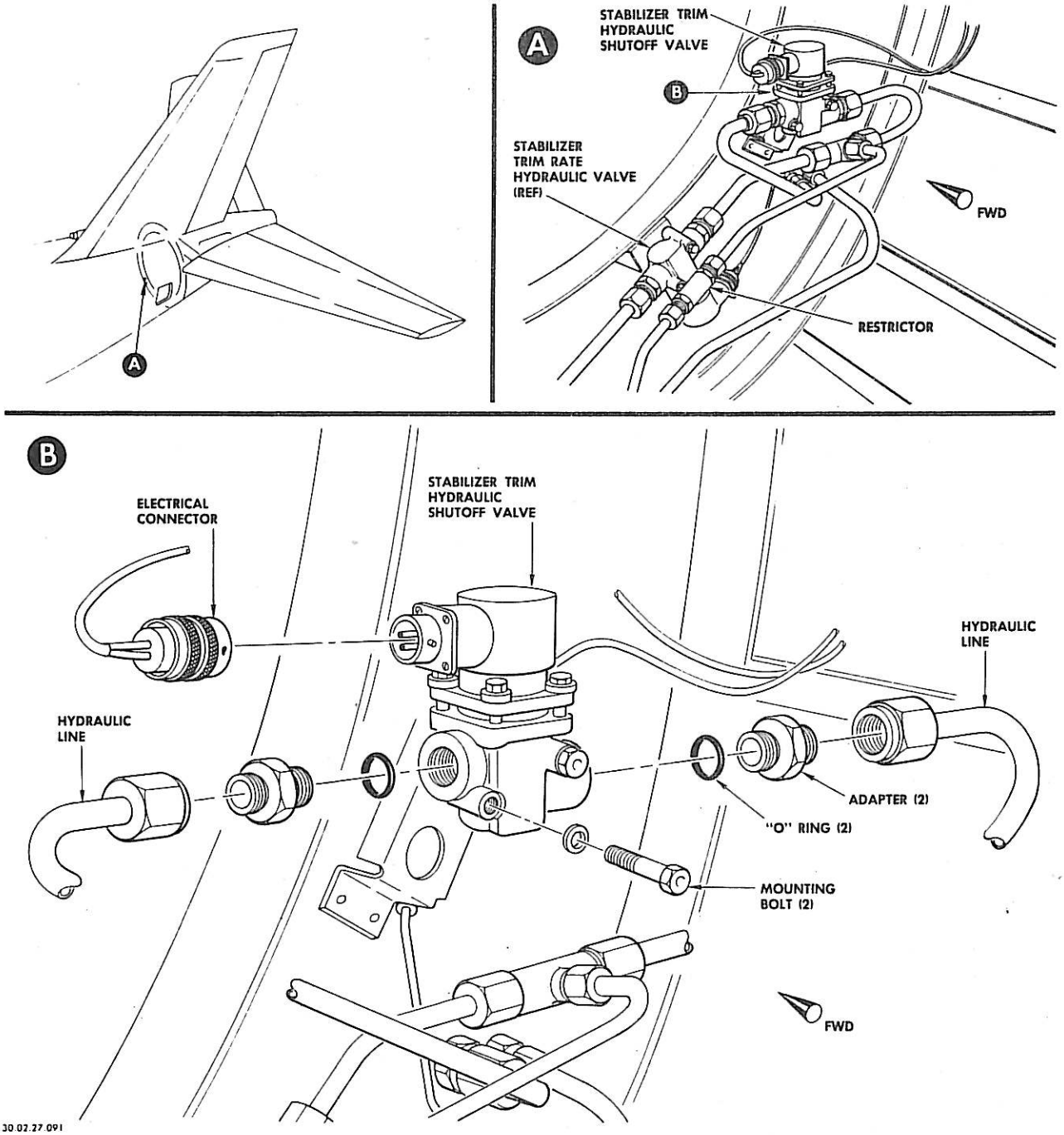
(8) Wipe up any spilled hydraulic fluid.

D. Install Stabilizer Trim Hydraulic Shutoff Valve.

(1) Position valve on mounting bracket and install two attaching bolts.

(2) Connect hydraulic lines to valve inlet and outlet ports.

(3) Connect electrical connector to valve electrical outlet.



Stabilizer Trim Hydraulic Shutoff Valve Installation
Figure 201

(4) Close STAB TRIM CONT EMER circuit breaker.

(5) Bleed stabilizer control hydraulic system (refer to Adjustment/Test Horizontal Stabilizer Trim System Bleeding Procedure).

(6) Test system (refer to 27-6-0, Adjustment/Test Horizontal Stabilizer Trim System Functional Test).

NOTE: If the stabilizer trim hydraulic shutoff valve only has been replaced and no other rigging or adjustment has been changed, check stabilizer trim system operation per 27-6-0, step 3.H.(13).

STABILIZER AUTOPILOT TRIM RATE HYDRAULIC VALVE - MAINTENANCE PRACTICES

1. Removal/Installation Stabilizer Trim Rate Hydraulic Valve (see Figure 201)

A. Equipment Required.

(1) Stand suitable for entering tail cone forward access door.

(2) Sheet metal plate or trough and flat container suitable for draining disconnected hydraulic lines.

B. Remove Stabilizer Autopilot Trim Rate Hydraulic Valve.

(1) Open AUTO PLT TRIM & RATE LIMIT (HYD) circuit breaker on main circuit breaker panel.

(2) Disconnect electrical connector from rate valve.

(3) Remove clamp used to support restrictor.

(4) Position trough, or sheet metal bent to a slightly "V" shape, beneath valve and leading to flat container.

(5) Disconnect two hydraulic lines from rate valve.

(6) Remove two mounting bolts and remove valve.

C. Install Stabilizer Trim Rate Hydraulic Valve.

(1) Position rate valve on mounting bracket and install two mounting bolts.

(2) Connect hydraulic lines.

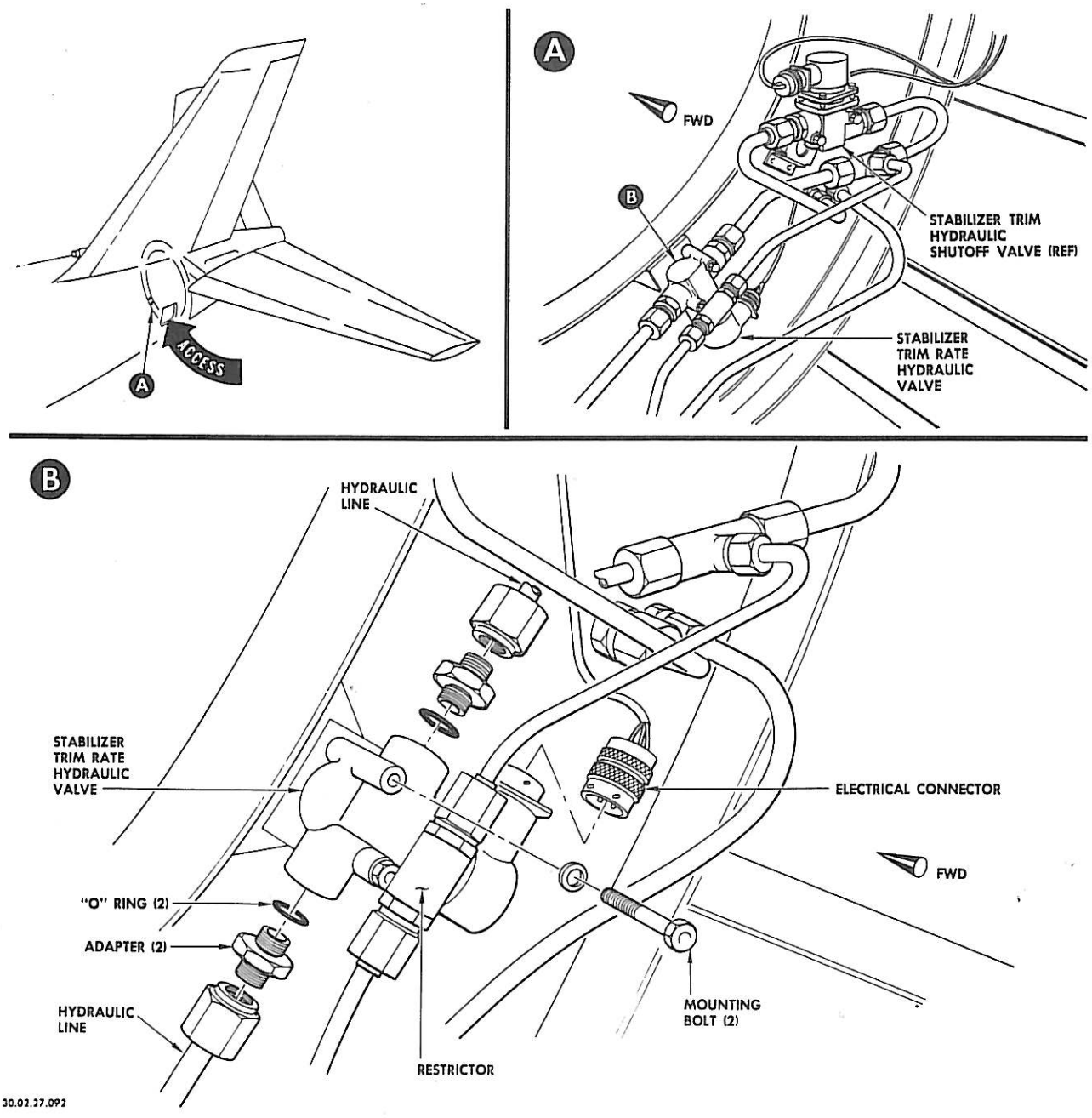
(3) Connect electrical connector.

(4) Install clamp and secure restrictor to side of rate valve.

(5) Close AUTO PLT TRIM & RATE LIMIT (HYD) circuit breaker.

(6) Bleed hydraulic system (refer to 27-6-0, Adjustment/Test Horizontal Stabilizer Trim System Bleeding Procedure.

(7) Check stabilizer trim system operation (refer to 27-6-0, Adjustment/Test Stabilizer Trim System Functional Test and Chapter 22, AUTOPILOT).



Stabilizer Auto Pilot Trim Rate
Hydraulic Valve Installation
Figure 201

NOTE: If a stabilizer autopilot trim rate hydraulic valve only has been replaced and no other rigging or adjustment has been changed, check that stabilizer travels between 5-degree and 7-degree positions in 20 (±3) seconds with autopilot engaged and engage interlock circuit interruped (refer to Chapter 22, AUTOPILOT).

(8) Clean up spilled hydraulic fluid and close tail cone access door.

HORIZONTAL STABILIZER POSITION TRANSMITTER - MAINTENANCE PRACTICES

1. Removal/Installation Horizontal Stabilizer Position Transmitter (see Figure 201)

A. Equipment Required.

(1) Stand suitable for entering tail cone aft access door.

(2) Protractor No. 30-00003-901 RGTL No. 1 to measure horizontal stabilizer travel.

B. Remove Horizontal Stabilizer Position Transmitter.

(1) Open STAB POS IND circuit breaker on main circuit breaker panel.

(2) Open tail cone aft access door.

(3) Disconnect electrical connector from position transmitter.

(4) Loosen transmitter arm calmping bolt and slip arm off transmitter shaft.

(5) Remove four transmitter mounting screws and remove transmitter.

C. Install Horizontal Stabilizer Position Transmitter.

(1) Position stabilizer position transmitter on mounting bracket and install four mounting screws.

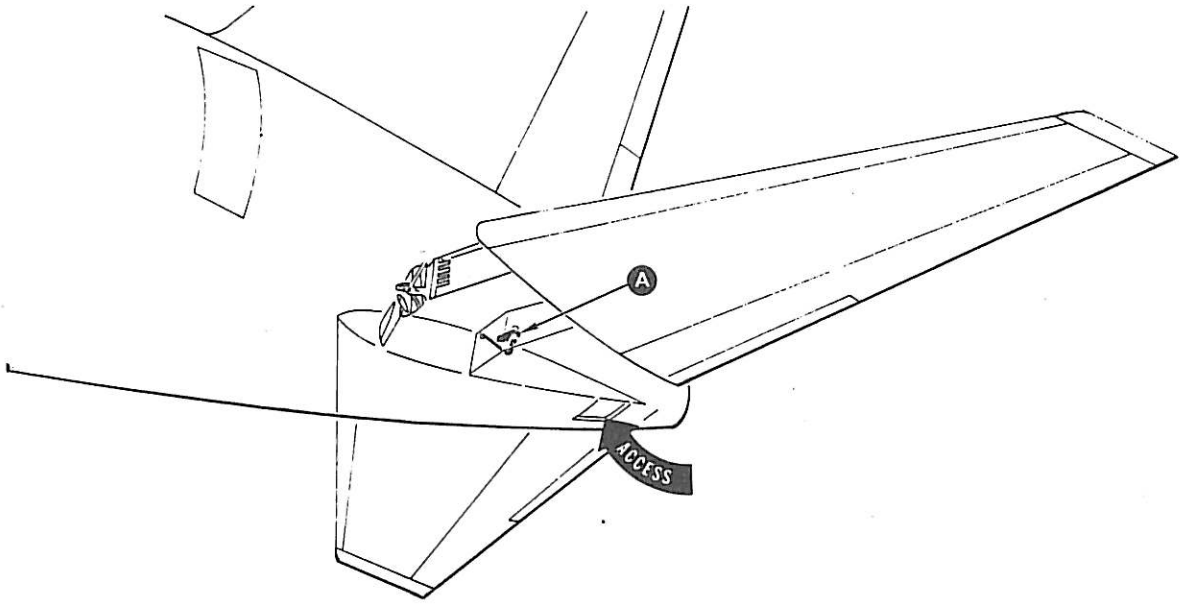
(2) Slip transmitter arm on transmitter shaft and tighten clamping bolt.

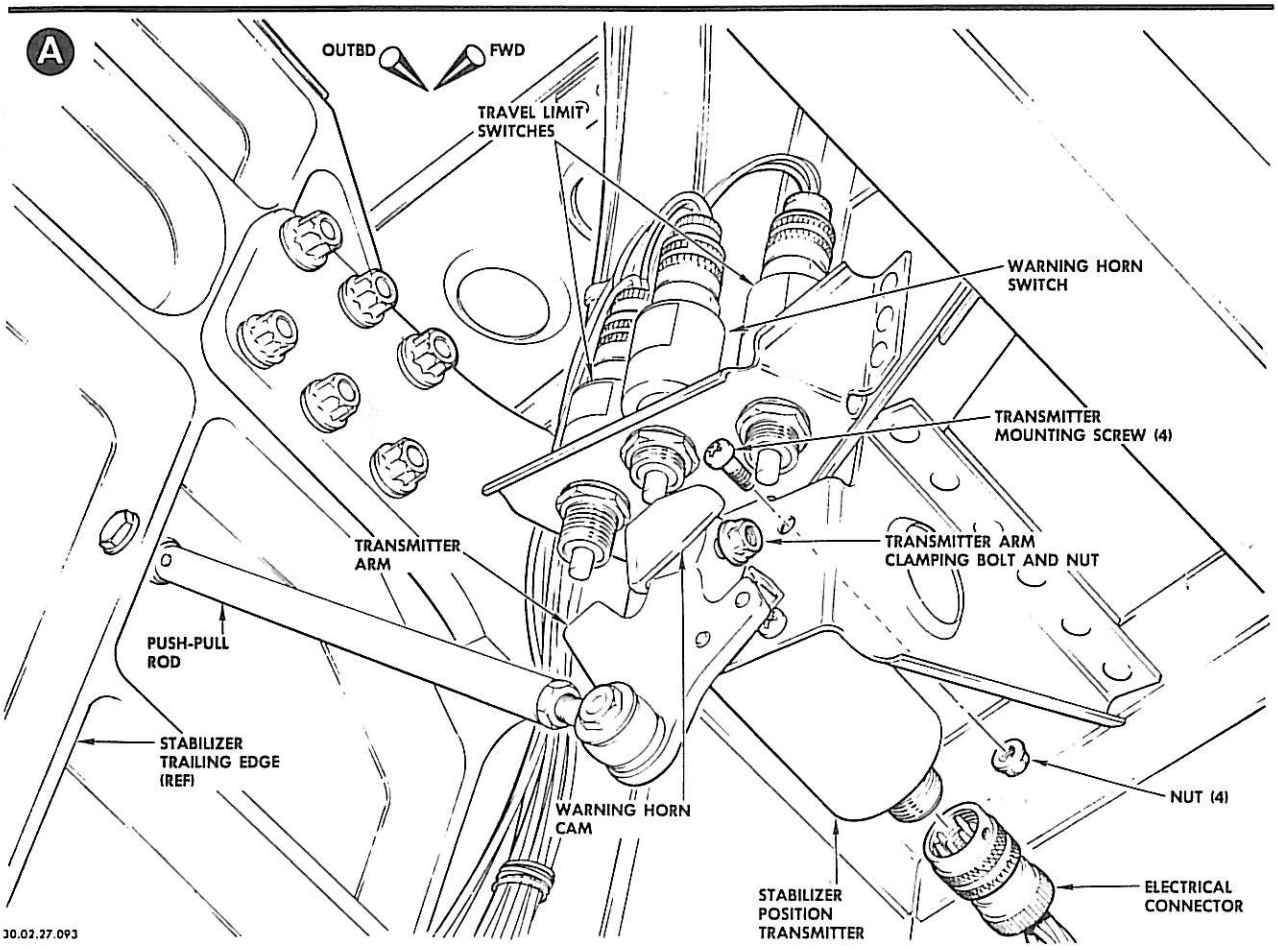
(3) Connect electrical connector.

(4) Adjust transmitter (refer to 27-6-0, Adjustment/Test Adjust Horizontal Stabilizer Trim System, paragraph 1.F.).

(5) Check stabilizer trim system operation (refer to 27-6-0, Adjustment/Test Stabilizer Trim System Functional Test).

NOTE: If the stabilizer position transmitter only has been replaced and no other rigging or adjustment has been changed, check stabilizer trim system operation per 27-6-0, paragraph 3.C.





Horizontal Stabilizer Position Transmitter
Figure 201

STABILIZER MOTION INDICATOR - MAINTENANCE PRACTICES

1. Removal/Installation - Stabilizer Motion Indicator (see Figure 201)

   A. Equipment Required. None.

   B. Remove Stabilizer Motion Indicator.

      (1) Remove pilots' pedestal side cover (LH).

      (2) Loosen knurled collar and detach flexible shaft from motion indicator.

      (3) Remove three mounting bolts and detach motion indicator from pilots' pedestal.

   C. Install Stabilizer Motion Indicator.

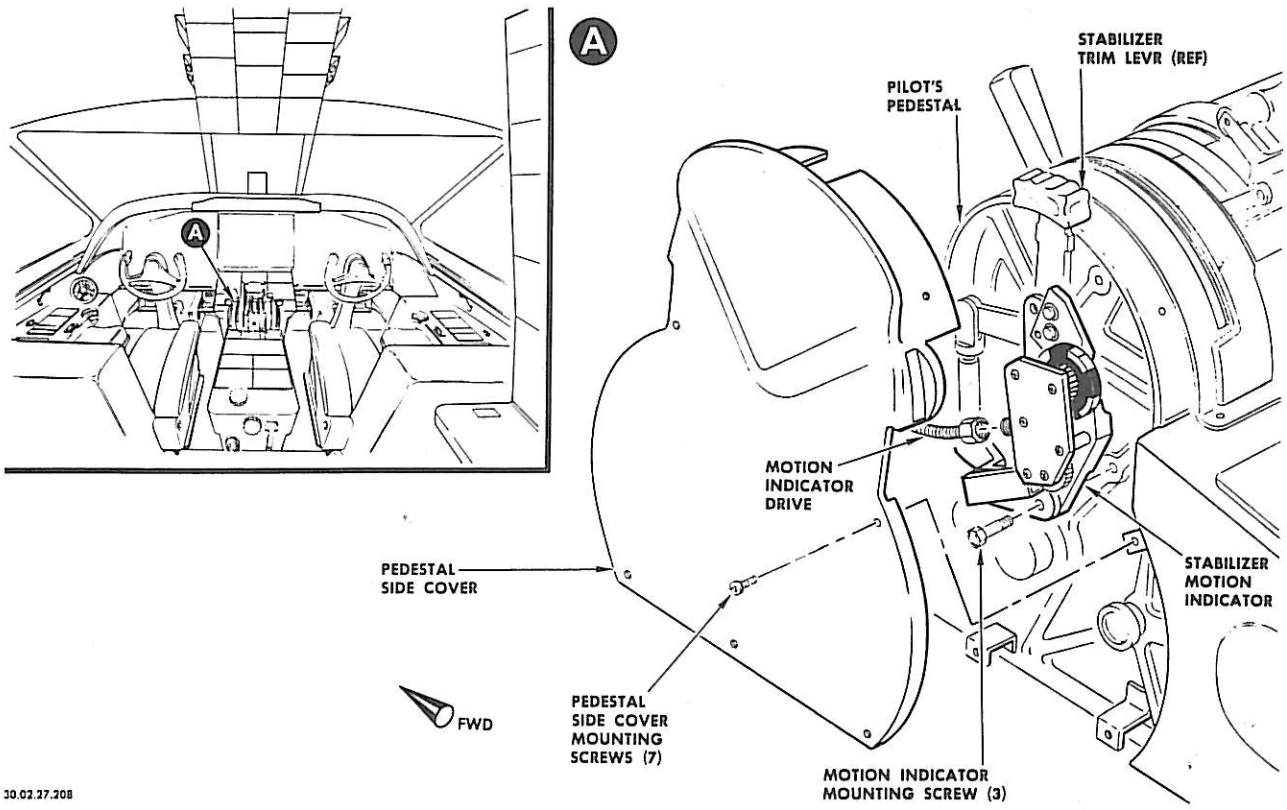
      (1) Position stabilizer motion indicator on LH side of pilots' pedestal and install three mounting bolts.

      (2) Install and tighten knurled collar attaching flexible shaft to motion indicator.

      (3) Check stabilizer trim system operation (refer to 27-6-0, Adjustment/Test Stabilizer Trim System Functional Test).

      NOTE: If the stabilizer motion indicator only has been replaced and no other rigging or adjustment has been changed, check stabilizer trim system operation per 27-6-0, steps 3.E.(4) and 3.E.(7).

      (4) Install pilots' pedestal side cover.



Stabilizer Motion Indicator Installation
Figure 201

SPEED STABILITY MACH COMPUTER - MAINTENANCE PRACTICES

1. Removal/Installation Speed Stability Mach Computer (see Figure 201)

A. Equipment Required.

(1) Stand suitable for entering electrical and electronics compartment.

B. Remove Speed Stability Mach Computer.

(1) Open SPEED STABILITY AC and DC circuit breakers on main circuit breaker panel.

(2) Open electrical and electronics compartment access door.

(3) Disconnect electrical connector from mach computer.

(4) Disconnect pitot and static air lines from mach computer.

(5) Remove four mounting bolts attaching mounting bracket to equipment rack and remove computer with bracket. Make sure that bonding jumper is free.

C. Install Speed Stability Mach Computer.

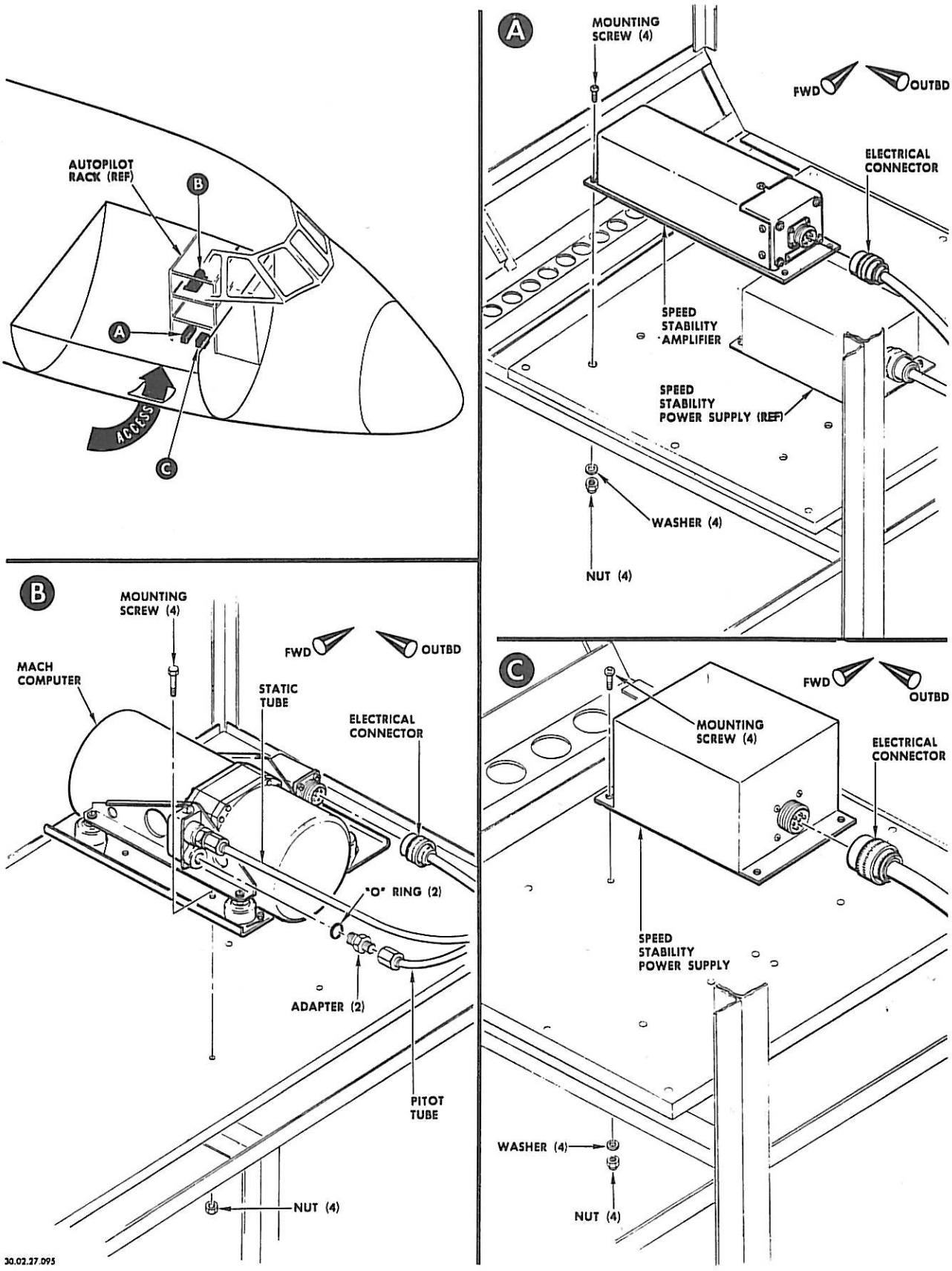
(1) Position mach computer in equipment rack and install four mounting bolts. Make sure that bonding jumper is connected when bolts are installed.

(2) Connect pitot and static air lines.

(3) Connect electrical connector.

(4) Close SPEED STABILITY AC and DC circuit breakers on main circuit breaker panel and test system (refer to 27-6-0, Adjustment/Test Tuck Compensator System Functional Test).

NOTE: If the speed stability mach computer only has been replaced and no other rigging or adjustment has been changed, check stabilizer trim system operation per 27-6-0, paragraph 4.D.


AUTOPILOT RACK (REF)
B
A
ACCESS
C
A
MOUNTING SCREW (4)
FWD
OUTBD
ELECTRICAL CONNECTOR
SPEED STABILITY AMPLIFIER
SPEED STABILITY POWER SUPPLY (REF)
WASHER (4)
NUT (4)
B
MOUNTING SCREW (4)
FWD
OUTBD
MACH COMPUTER
STATIC TUBE
ELECTRICAL CONNECTOR
"O" RING (2)
ADAPTER (2)
PITOT TUBE
NUT (4)
C
FWD
OUTBD
MOUNTING SCREW (4)
ELECTRICAL CONNECTOR
SPEED STABILITY POWER SUPPLY
WASHER (4)
NUT (4)
30.02.27.095

SPEED STABILITY POWER SUPPLY - MAINTENANCE PRACTICES

1. Removal/Installation Speed Stability Power Supply (see 27-6-10, Figure 201)

A. Equipment Required.

(1) Step or stand to provide entrance to electrical and electronics compartment.

B. Remove Speed Stability Power Supply.

(1) Open SPEED STABILITY AC and DC circuit breakers on main circuit breaker panel.

(2) Open electrical and electronics compartment access door.

(3) Disconnect electrical connector from power supply.

(4) Remove four mounting bolts and remove power supply from equipment rack.

C. Install Speed Stability Power Supply.

(1) Position power supply in equipment rack and install four mounting bolts. Make sure that paint is cleaned away from around one bolt hole so that unit will be properly bonded.

(2) Connect electrical connector.

(3) Close SPEED STABILITY circuit breaker and test system (refer to 27-6-0, Adjustment/Test Tuck Compensator System Functional Test).

NOTE: If the speed stability power supply only has been replaced and no other rigging or adjustment has been changed, check stabilizer trim system operation per 27-6-0, paragraph 4.D.

SPEED STABILITY POWER AMPLIFIER - MAINTENANCE PRACTICES

1. Removal/Installation Speed Stability Power Amplifier (see 27-6-10, Figure 201)

   A. General.

      Removal and installation procedures for speed stability power amplifier are identical to removal and installation procedures outlined for speed stability power supply. To remove and install power amplifier, refer to Removal/Installation Speed Stability Power Supply.

STABILIZER TRIM SWITCHES - MAINTENANCE PRACTICES

1. Removal/Installation Stabilizer Trim Switches (see Figure 201)

A. General.

The stabilizer trim switches are mounted on the aft faces of the outboard horns of the pilot's and copilot's control wheels.

B. Equipment Required.

(1) Stand suitable for reaching forward fuselage access door.

C. Remove Pilot's Stabilizer Trim Switch.

NOTE: Removal and installation procedures for the pilot's and copilot's control wheel stabilizer trim switches are identical.

(1) Open MAN STAB TRIM, AUTOPILOT, and EMER & DOME LTS circuit breakers on main circuit breaker panel and AUDIO SELECT circuit breaker on avionics circuit breaker panel.

(2) Cut 16 electrical wires in control column harness at permanent splices beneath flight deck floor.

(3) Remove cap from top of control column.

(4) Remove screws in clamp that secures upper end of electrical harness and pull harness upward out of electrical conduit.

(5) Remove two switch retaining screws from forward face of control wheel outboard horn and remove trim switch from switch socket.

(6) Pull six wires attached to trim switch out of electrical harness through switch opening in control wheel horn.

D. Install Pilot's Stabilizer Trim Switch.

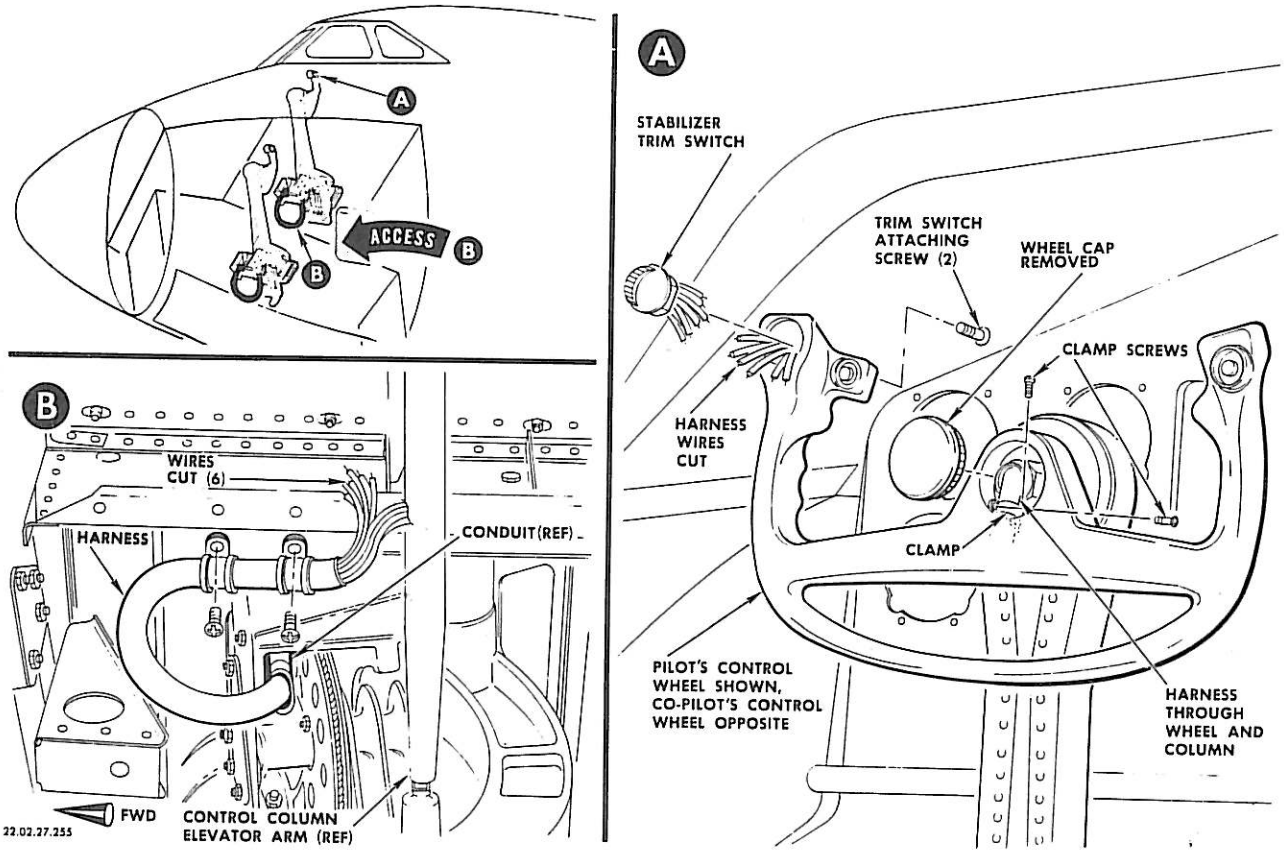
(1) Insert six wires attached to replacement stabilizer trim switch through switch opening in control wheel horn and through control wheel harness.

(2) Position trim switch in switch opening in control wheel and install two retaining screws.

(3) Install electrical harness in conduit in control column and tighten clamps that secure upper end of electrical harness.

(4) Splice 16 wires in electrical harness at permanent splices beneath flight deck floor.

(5) Replace cap on top of control column.


A
ACCESS
B
B
WIRES CUT (6)
HARNESS
CONDUIT (REF)
FWD
CONTROL COLUMN ELEVATOR ARM (REF)
22.02.27.255
A
STABILIZER TRIM SWITCH
TRIM SWITCH ATTACHING SCREW (2)
WHEEL CAP REMOVED
CLAMP SCREWS
HARNESS WIRES CUT
CLAMP
PILOT'S CONTROL WHEEL SHOWN, CO-PILOT'S CONTROL WHEEL OPPOSITE
HARNESS THROUGH WHEEL AND COLUMN

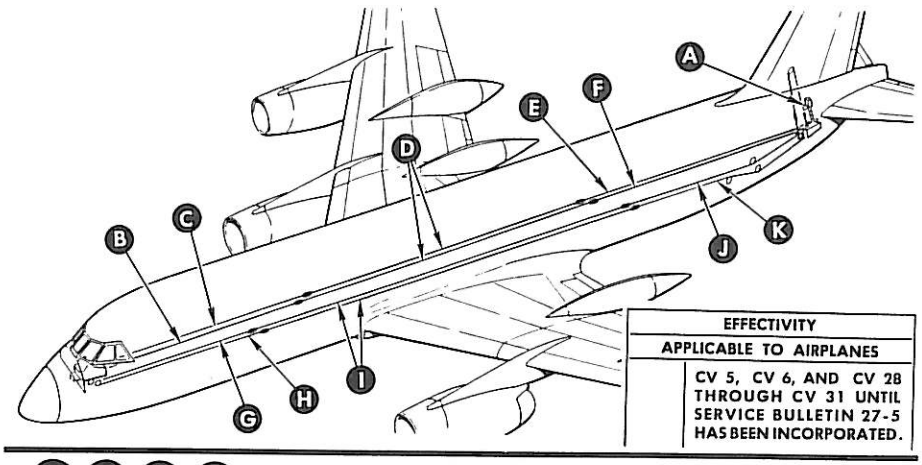
(6) Close MAN STAB TRIM, AUTOPILOT, and EMERG & DOME LTS circuit breakers.

(7) Check autopilot operation (refer to Chapter 22, AUTOPILOT).

(8) Check flight compartment dome light operation (refer to Chapter 33, LIGHTS).

(9) Check stabilizer trim operation (refer to 27-6-0, Adjustment/Test Stabilizer Trim System Functional Test).

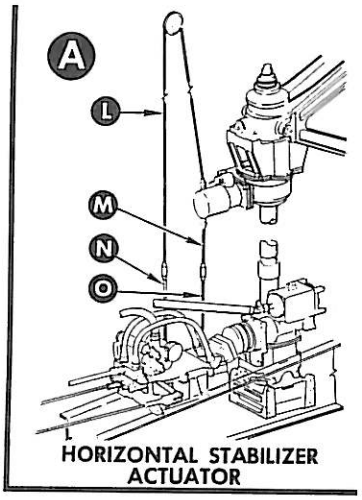
NOTE: If a stabilizer trim switch only has been replaced and no other rigging or adjustment has been changed, check stabilizer trim operation per 27-6-0, steps 3.G.(1) through 3.G.(9).



EFFECTIVITY

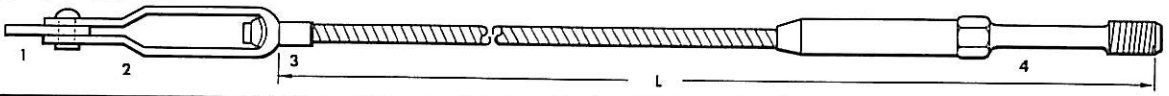
APPLICABLE TO AIRPLANES

CV 5, CV 6, AND CV 28 THROUGH CV 31 UNTIL SERVICE BULLETIN 27-5 HAS BEEN INCORPORATED.

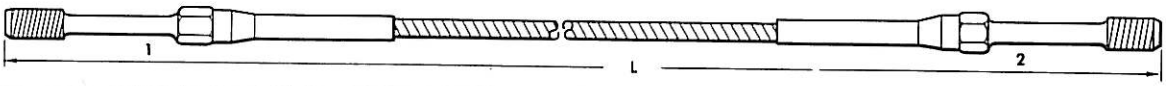


HORIZONTAL STABILIZER ACTUATOR

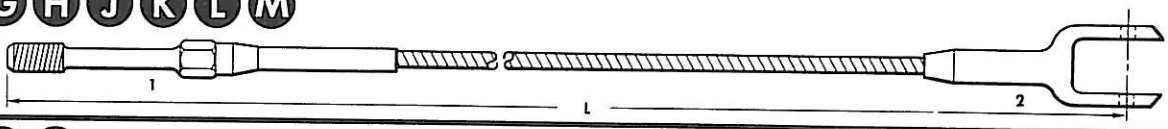
B C E F



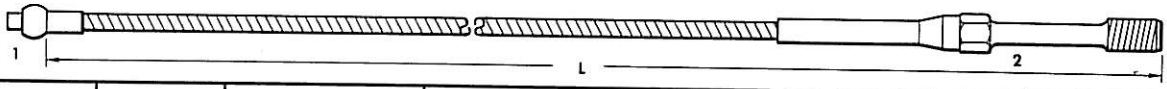
D I



G H J K L M



N O



CABLE REFERENCE	NUMBER REQUIRED	LENGTH	CABLE SIZE	FITTINGS 1	2	3	4
B	1	273.98	3/32 × 7 × 7	30-40911-499	98-91503-003	AN 664C3	30-40915-7
C	1	311.50	3/32 × 7 × 7	30-40911-499	98-91503-003	AN 664C3	30-40915-7
D	2	624.88	1/16 × 7 × 7	NAS 650-S2LH	NAS2 650-S2RH		
E	1	336.70	3/32 × 7 × 7	30-40911-499	98-91503-003	AN 664C3	30-40915-9
F	1	377.30	3/32 × 7 × 7	30-40911-499	98-91503-003	AN 664C3	30-40915-9
G	1	233.30	3/32 × 7 × 7	NAS 650-L3RH	30-40912-7		
H	1	213.45	3/32 × 7 × 7	NAS 650-L3RH	30-40912-7		
I	2	971.25	3/32 × 1 × 19	NAS 650-L3LH	NAS 650-L3RH		
J	1	102.65	3/32 × 7 × 7	NAS 650-L3LH	30-40912-7		
K	1	124.00	3/32 × 7 × 7	NAS 650-L3LH	30-40912-7		
L	1	88.00	3/32 × 7 × 7	NAS 650-L3RH	AN 667-3		
M	1	5.80	3/32 × 7 × 7	NAS 650-S3LH	AN 667-3		
N	1	63.70	3/32 × 7 × 7	AN 664C3	NAS 650-L3LH		
O	1	49.40	3/32 × 7 × 7	AN 664C3	NAS 650-S3RH		

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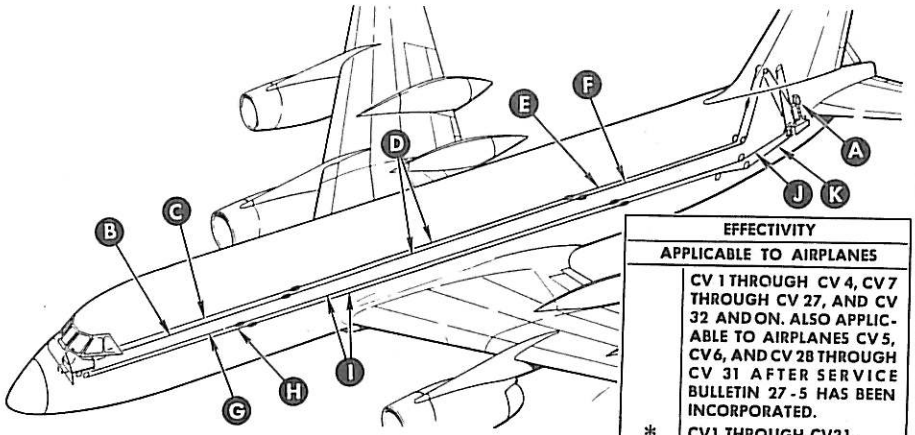
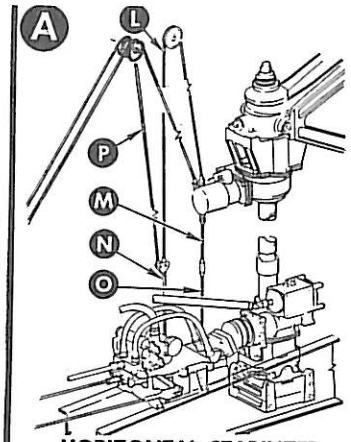
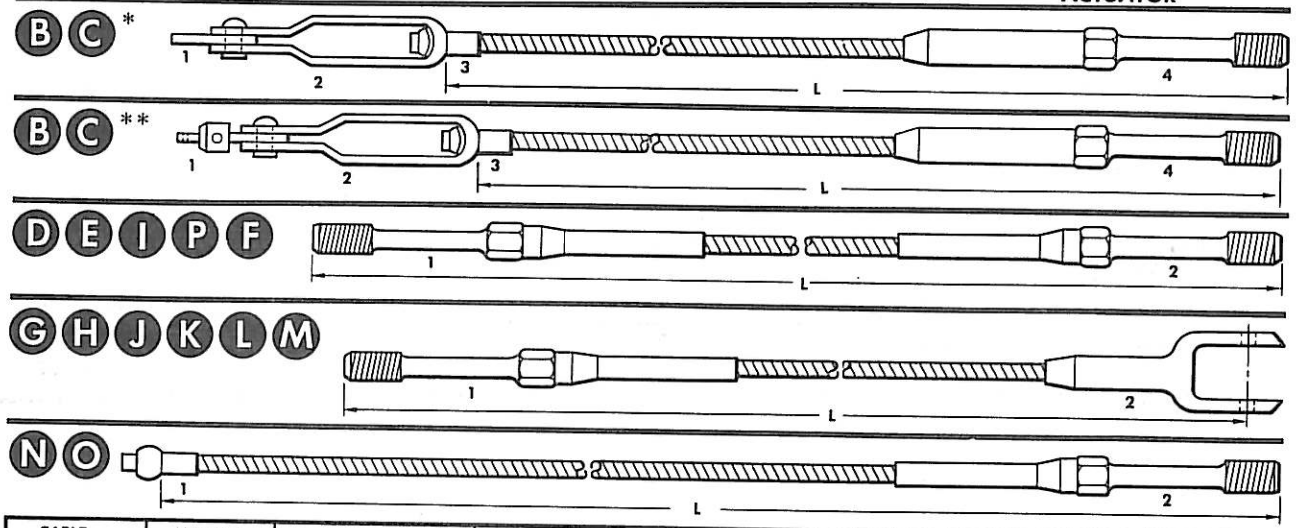


EFFECTIVITY	
APPLICABLE TO AIRPLANES	
	CV 1 THROUGH CV 4, CV 7 THROUGH CV 27, AND CV 32 AND ON. ALSO APPLICABLE TO AIRPLANES CV 5, CV 6, AND CV 28 THROUGH CV 31 AFTER SERVICE BULLETIN 27-5 HAS BEEN INCORPORATED.
*	CV 1 THROUGH CV 31.
**	CV 32 AND ON AND SPARES.



HORIZONTAL STABILIZER ACTUATOR



CABLE REFERENCE	NUMBER REQUIRED	LENGTH	CABLE SIZE	FITTINGS 1	2	3	4
B*	1	268.55	3/32 × 7 × 7	30-40911-499	98-91503-003	AN 664C3	NAS650-S3RH
C*	1	311.50	3/32 × 7 × 7	30-40911-499	98-91503-003	AN 664C3	NAS650-S3RH
B**	1	268.55	3/32 × 7 × 7	30-41320-1	98-91503-003	AN 664C3	NAS650-S3RH
C**	1	311.50	3/32 × 7 × 7	30-41320-1	98-91503-003	AN 664C3	NAS650-S3RH
D	2	624.88	1/16 × 7 × 7	NAS 650-S3LH	NAS2 650-S3RH		
E	1	423.62	3/32 × 7 × 7	NAS650-S3RH	NAS650-S3RH		
F	1	475.40	3/32 × 7 × 7	NAS650-S3RH	NAS650-S3RH		
G	1	233.30	3/32 × 7 × 7	NAS 650-L3RH	30-40912-7		
H	1	213.45	3/32 × 7 × 7	NAS 650-L3RH	30-40912-7		
I	2	971.25	3/32 × 1 × 19	NAS 650-L3LH	NAS 650-L3RH		
J	1	102.65	3/32 × 7 × 7	NAS 650-L3LH	30-40912-7		
K	1	124.00	3/32 × 7 × 7	NAS 650-L3LH	30-40912-7		
L	1	81.42	3/32 × 7 × 7	NAS 650-S3RH	AN 668-3		
M	1	5.80	3/32 × 7 × 7	NAS 650-S3LH	AN 667-3		
N	1	63.70	3/32 × 7 × 7	AN 664C3	NAS 650-L3LH		
O	1	49.40	3/32 × 7 × 7	AN 664C3	NAS 650-S3RH		
P	1	91.85	3/32 X 7 X 7	NAS 650-S3LH	AN 668-3		

30.02.27.052-2C

Stabilizer Trim Control System Cables
Figure 201 (Sheet 2 of 2)

RUDDER CONTROL SYSTEM - DESCRIPTION AND OPERATION

1. General

The rudder control system consists primarily of adjustable rudder pedals, "feel" system, control package, hydraulic control system, rudder warning system, flight tab, and rudder. There are two modes of rudder operation; the normal (power) mode and the manual (stand-by) mode. Rudder pedal movement is transmitted to a servo valve in power mode, or to the rudder flight tab in manual mode, through a mechanical linkage consisting of cables, bell cranks, and control rods (see Figure 1).

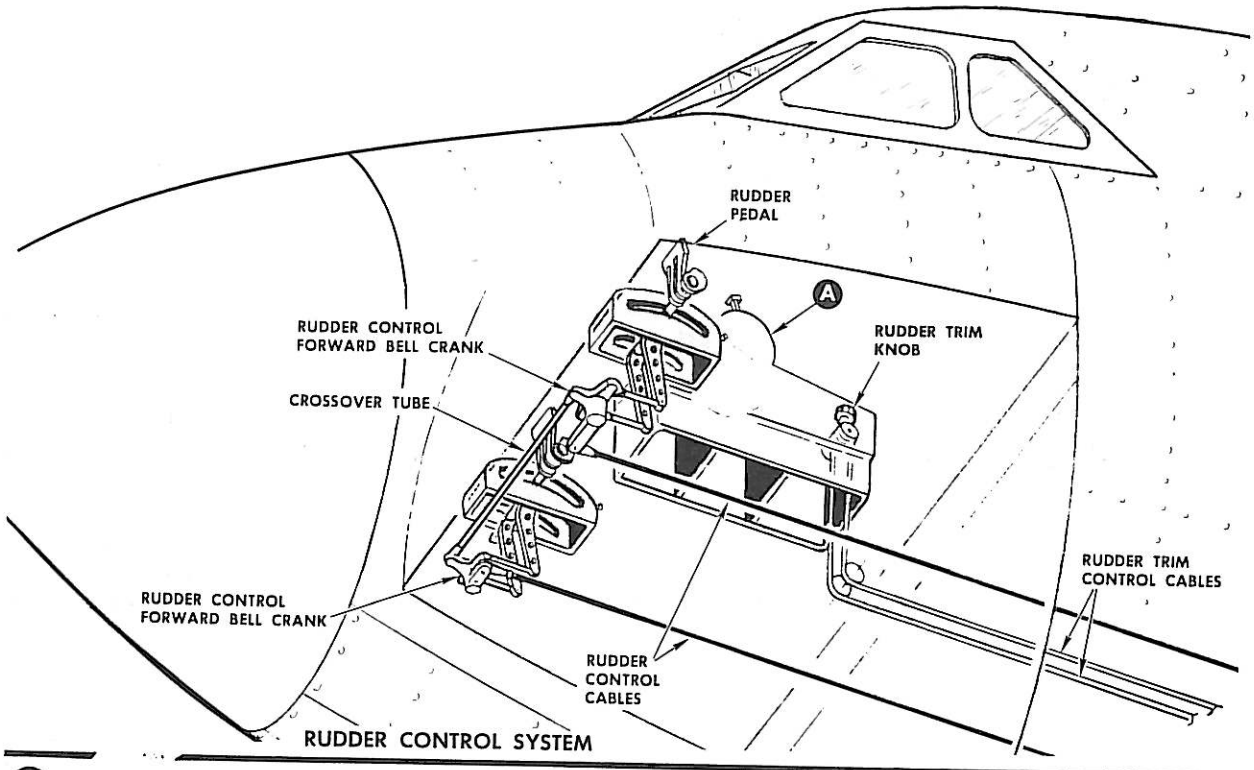
A single, 1/8-inch, non-flex cable extends aft from each rudder control forward bell crank, beneath the cabin floor and through seals in the pressure bulkhead, to a rudder control aft bell crank in the tail cone. Cables extend up from the aft bell cranks to two idler bell cranks in the vertical stabilizer. From the idlers, the cables are routed up to the rudder control quadrant bell crank. Autopilot rudder servo cables are attached to the rudder control quadrant. Rudder pedal action is transmitted from the quadrant bell crank to the upper bell crank and from there to mixer No. 2 in the rudder control package by push-pull rods.

In power mode of operation the flight tab control linkage is locked in the neutral position by the power-to-manual reversion mechanism in the control package and the rudder is actuated by two pairs of hydraulic actuators. Each of the airplane's two hydraulic systems supplies power to one pair of actuators and either system will provide fully effective rudder control (see Figure 2). The dual servo valve, in the control package, provides control of the hydraulic actuators. A followup linkage, to coordinate rudder deflection with rudder pedal displacement, is formed by pivoting the servo valve actuating bell crank on the forward spar of the rudder (see Figure 3). When the rudder is deflected hydraulically, anti-servo action causes the flight tab to deflect an equal amount in the same direction.

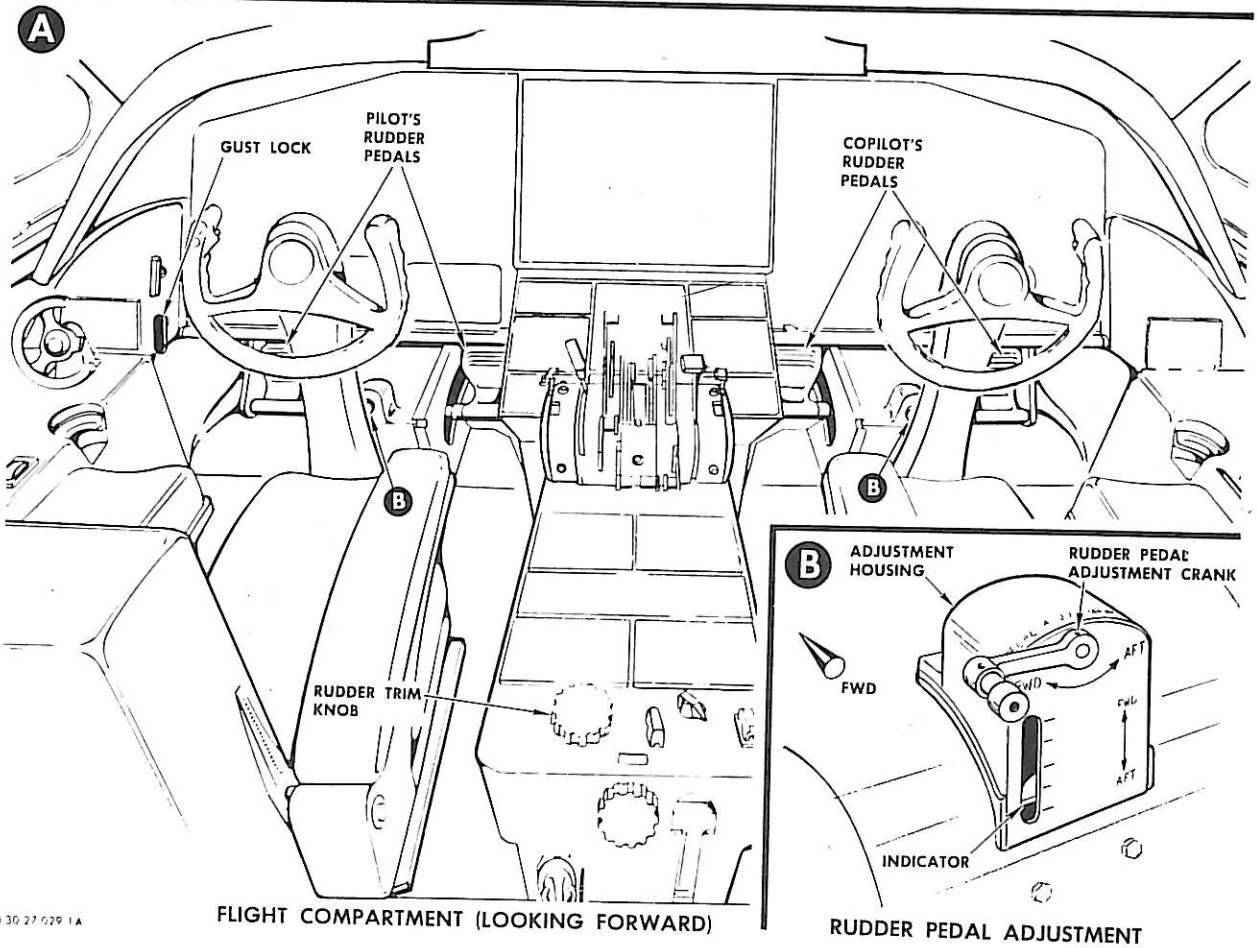
The hydraulic actuators are capable of developing sufficient power to fully deflect the rudder at high airspeeds. Since full deflection of the rudder at high speeds would exceed the structural limits of the airplane, force limiting relief valves are installed in the hydraulic control system to confine rudder deflection within safe limits.

Rudder "feel" is simulated by a "Q" cylinder which varies resistance to rudder pedal movement to correspond to variations in airspeed.

When hydraulic power is off, the rudder hydraulic actuators act as mechanical travel stops for the rudder and on the ground the actuators function as gust dampers. A gust lock on the pilot's auxiliary instrument panel can be set to lock the rudder pedals in neutral and provide additional protection for the rudder.



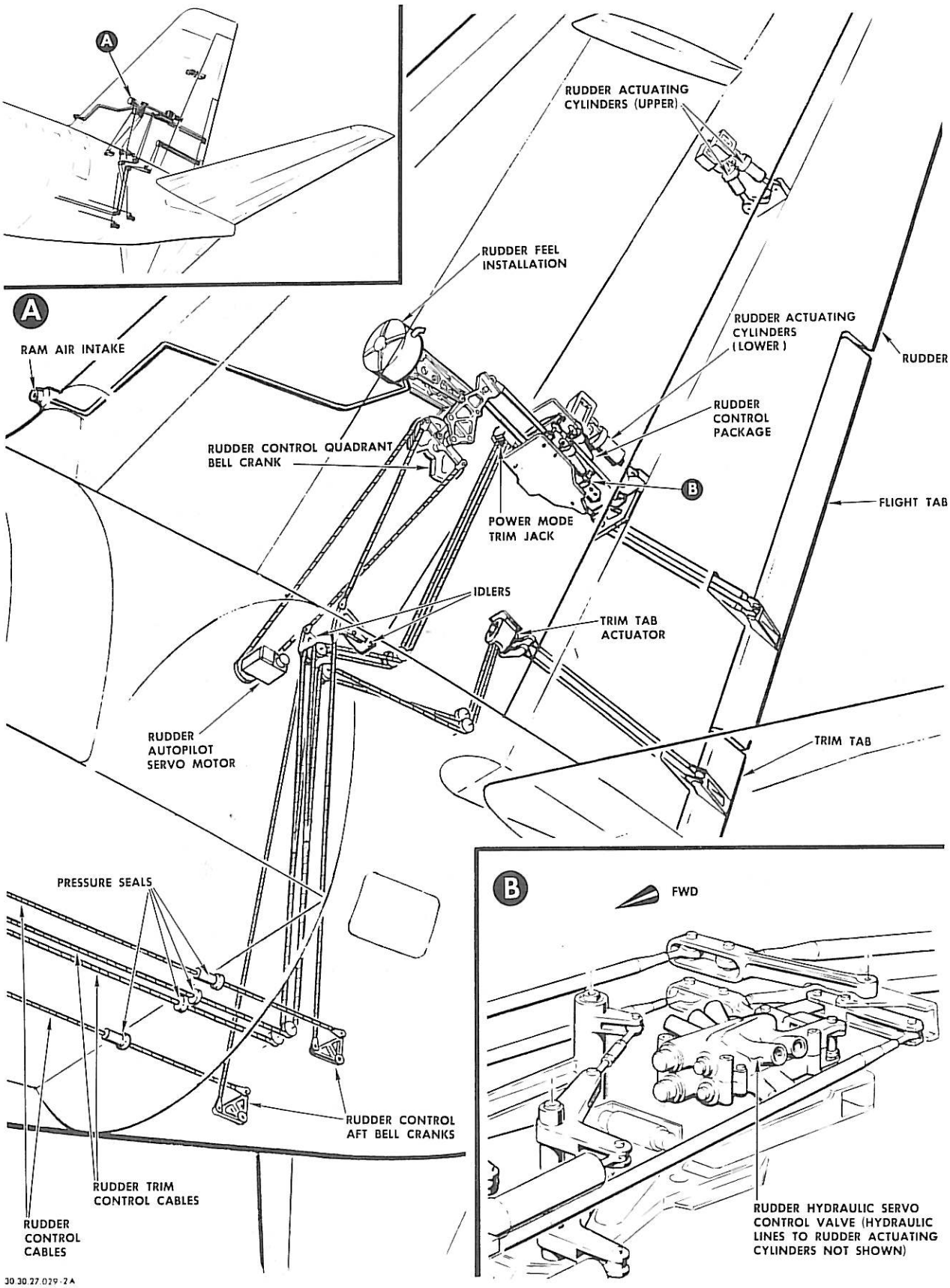
RUDDER CONTROL SYSTEM

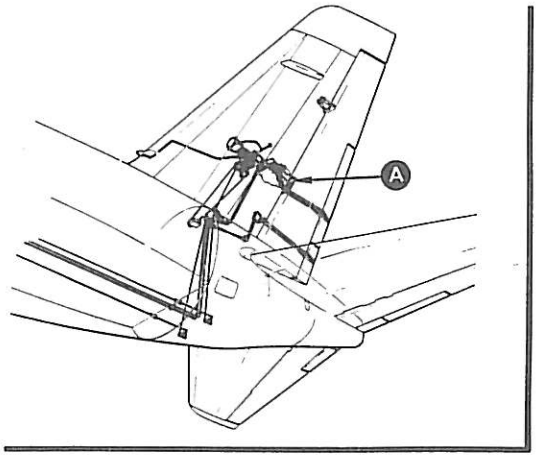


30 30 27 029 1A

FLIGHT COMPARTMENT (LOOKING FORWARD)

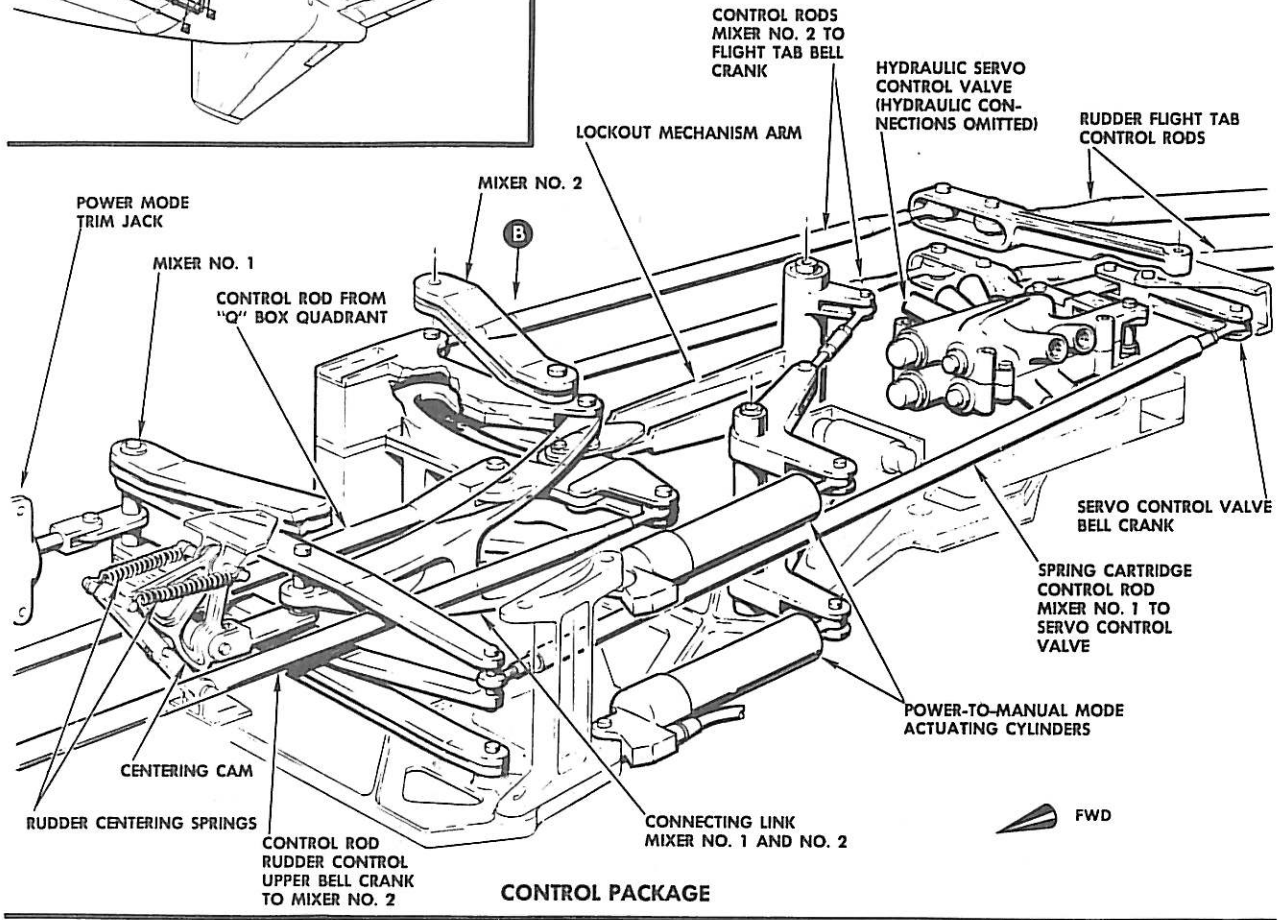
RUDDER PEDAL ADJUSTMENT


A
RUDDER ACTUATING CYLINDERS (UPPER)
RUDDER FEEL INSTALLATION
RAM AIR INTAKE
RUDDER ACTUATING CYLINDERS (LOWER)
RUDDER
RUDDER CONTROL PACKAGE
RUDDER CONTROL QUADRANT BELL CRANK
B
FLIGHT TAB
POWER MODE TRIM JACK
IDLERS
TRIM TAB ACTUATOR
RUDDER AUTOPILOT SERVO MOTOR
TRIM TAB
PRESSURE SEALS
B
FWD
RUDDER CONTROL AFT BELL CRANKS
RUDDER TRIM CONTROL CABLES
RUDDER CONTROL CABLES
RUDDER HYDRAULIC SERVO CONTROL VALVE (HYDRAULIC LINES TO RUDDER ACTUATING CYLINDERS NOT SHOWN)
30.30.27.029-2A

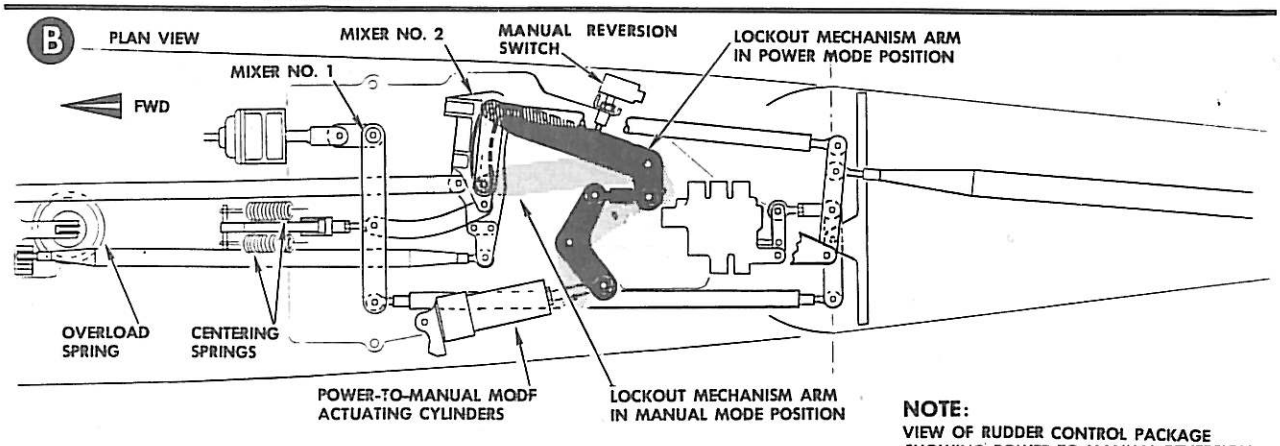


A VIEW LOOKING DOWN AND AFT

NOTE:
RUDDER CONTROL PACKAGE SHOWN IN MANUAL MODE POSITION.

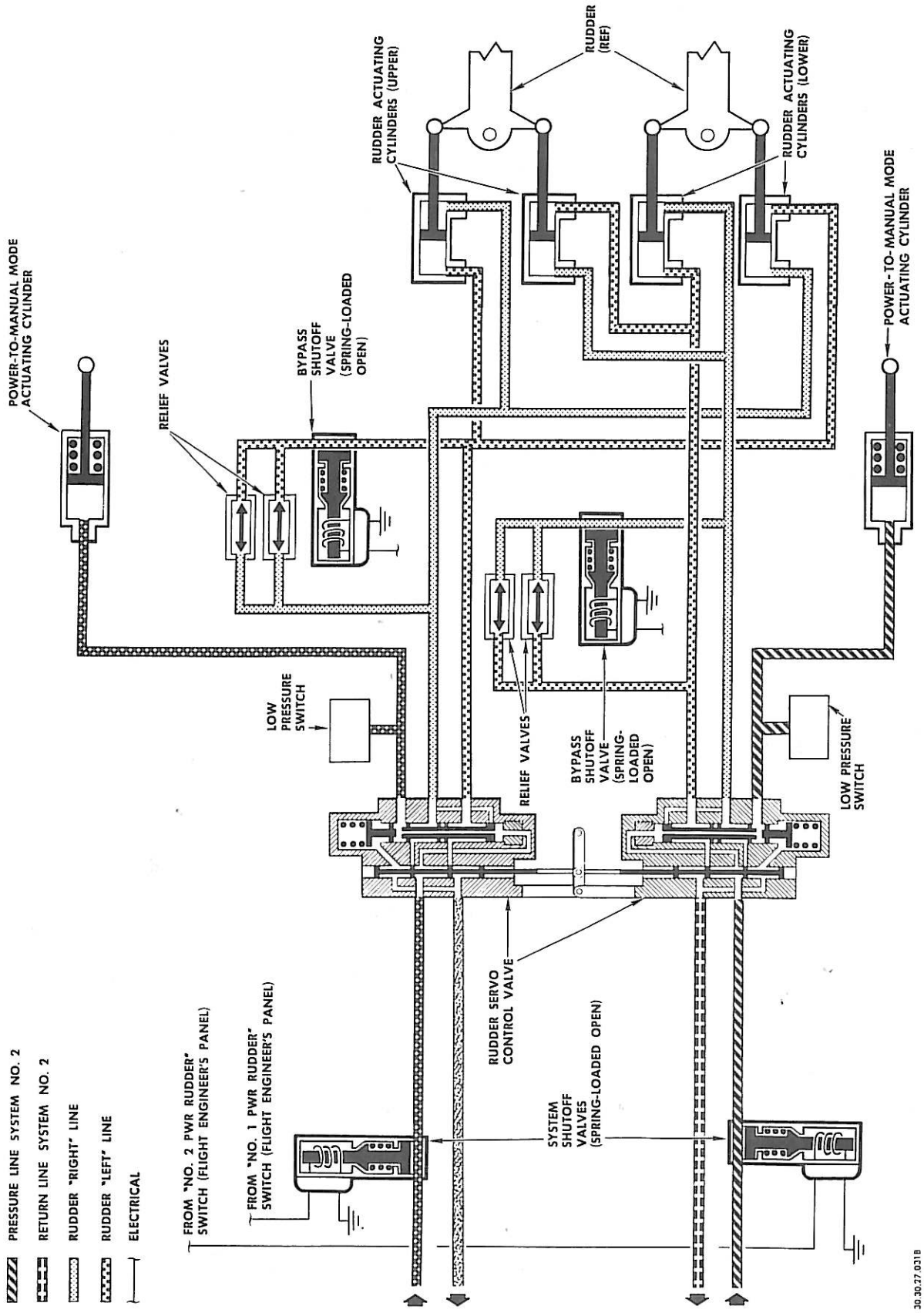


CONTROL PACKAGE



NOTE:
VIEW OF RUDDER CONTROL PACKAGE SHOWING POWER-TO-MANUAL REVERSION MECHANISM IN EACH POSITION.

30.30.27.030C


RUDDER (REF)
RUDDER ACTUATING CYLINDERS (UPPER)
RUDDER ACTUATING CYLINDERS (LOWER)
POWER-TO-MANUAL MODE ACTUATING CYLINDER
POWER-TO-MANUAL MODE ACTUATING CYLINDER
RELIEF VALVES
BYPASS SHUTOFF VALVE (SPRING-LOADED OPEN)
LOW PRESSURE SWITCH
RELIEF VALVES
BYPASS SHUTOFF VALVE (SPRING-LOADED OPEN)
LOW PRESSURE SWITCH
RUDDER SERVO CONTROL VALVE
SYSTEM SHUTOFF VALVES (SPRING-LOADED OPEN)
FROM "NO. 1 PWR RUDDER" SWITCH (FLIGHT ENGINEER'S PANEL)
FROM "NO. 2 PWR RUDDER" SWITCH (FLIGHT ENGINEER'S PANEL)
PRESSURE LINE SYSTEM NO. 1
RETURN LINE SYSTEM NO. 1
PRESSURE LINE SYSTEM NO. 2
RETURN LINE SYSTEM NO. 2
RUDDER "RIGHT" LINE
RUDDER "LEFT" LINE
ELECTRICAL
30.30.27.0318

2. Rudder and Rudder Flight Tab Travel

Full rudder travel during power operation is 25 degrees to the right and left of streamlined position. In the manual mode, rudder travel is limited aerodynamically to approximately 14 degrees left and right of neutral.

Full rudder flight tab travel is limited to 26.25 degrees in relation to the rudder surface. In power operation the flight tab control is locked in neutral and the flight tab is deflected the same amount and in the same direction as rudder deflection by the anti-servo linkage. In the manual mode, the flight tab is controlled through the mechanical linkage to the rudder pedals, and the rudder surface is deflected by aerodynamic forces acting on the deflected flight tab.

3. Rudder Pedals

The pilot's and copilot's rudder pedals are pivoted on the upper ends of swinging arms hinged below the flight compartment floor. Push-pull tubes connect the lower ends of each pair of rudder pedal arms to a forward bell crank. The forward bell cranks are interconnected by a crossover tube.

Each pair of rudder pedals can be adjusted fore and aft by rotating a hand crank located on the aft face of the linkage cover between each pair of pedals. The hand crank rotates a threaded shaft in pedal adjusting nuts which move the hinge points and the upper ends of the rudder pedal arms forward or aft as desired. The variable pedal setting enables a pilot to move the pedals to the position best suited to his physical stature. Adjustment of one set of pedals has no effect on the position of the other pair, nor any effect on the operation of the rudder system.

Rudder pedal travel is limited to 3.87 inches forward from the neutral position. To obtain this travel, the force limiting stops on the rudder control quadrant in the vertical stabilizer must first be contacted, and then sufficient force applied to the pedals to contact the pedal stops.

4. Rudder Pedal Gust Lock

The rudder pedal gust lock consists of a control handle, a spring cartridge, a shaft assembly, striker, lever and rocker assembly, solenoid, and locking pawls. The control handle is installed in the pilot's auxiliary instrument panel and is cable connected, through the spring cartridge, to a quadrant on the shaft assembly. Bell cranks on the ends of the shaft assembly are connected through links to the locking pawls. Unlocking springs, extend forward from the shaft assembly bell cranks and are connected to structural members. A striker is also mounted on the shaft assembly adjacent to the inboard bellcrank. A solenoid-actuated lever and rocker assembly is installed just below the striker.

When the gust lock control handle is pulled, the shaft assembly is rotated by the cable connected between the handle and the shaft assembly quadrant. The shaft assembly bell cranks rotate to drive the locking pawls against the lower ends of the pilot's rudder pedal arms. A solenoid-actuated lever

and rocker assembly engages the striker on the shaft and prevents use of the gust lock when hydraulic pressure is applied. Hydraulic pressure causes hydraulic system No. 1 pressure switch to open thereby breaking the circuit to the gust lock relay causing it to return to the closed position and route power to a solenoid which actuates the lever and rocker assembly and prevents operation of the gust lock. The spring cartridge in the cable between the pedal lock and the control handle is provided so that when locking pawls reach the locked position, the control handle can be pulled out, compressing the spring, and locked in a position that will interfere with the operation of the nose wheel steering wheel. When the gust lock control handle is released, the unlocking springs rotate the shaft assembly to the unlocked position. The gust lock locks only the rudder pedals and rudder flight tab. When the rudder swings in the wind, the flight tab anti-servos, but fast motion of rudder or flight tab is prevented by the gust dampening function of the rudder hydraulic actuators.

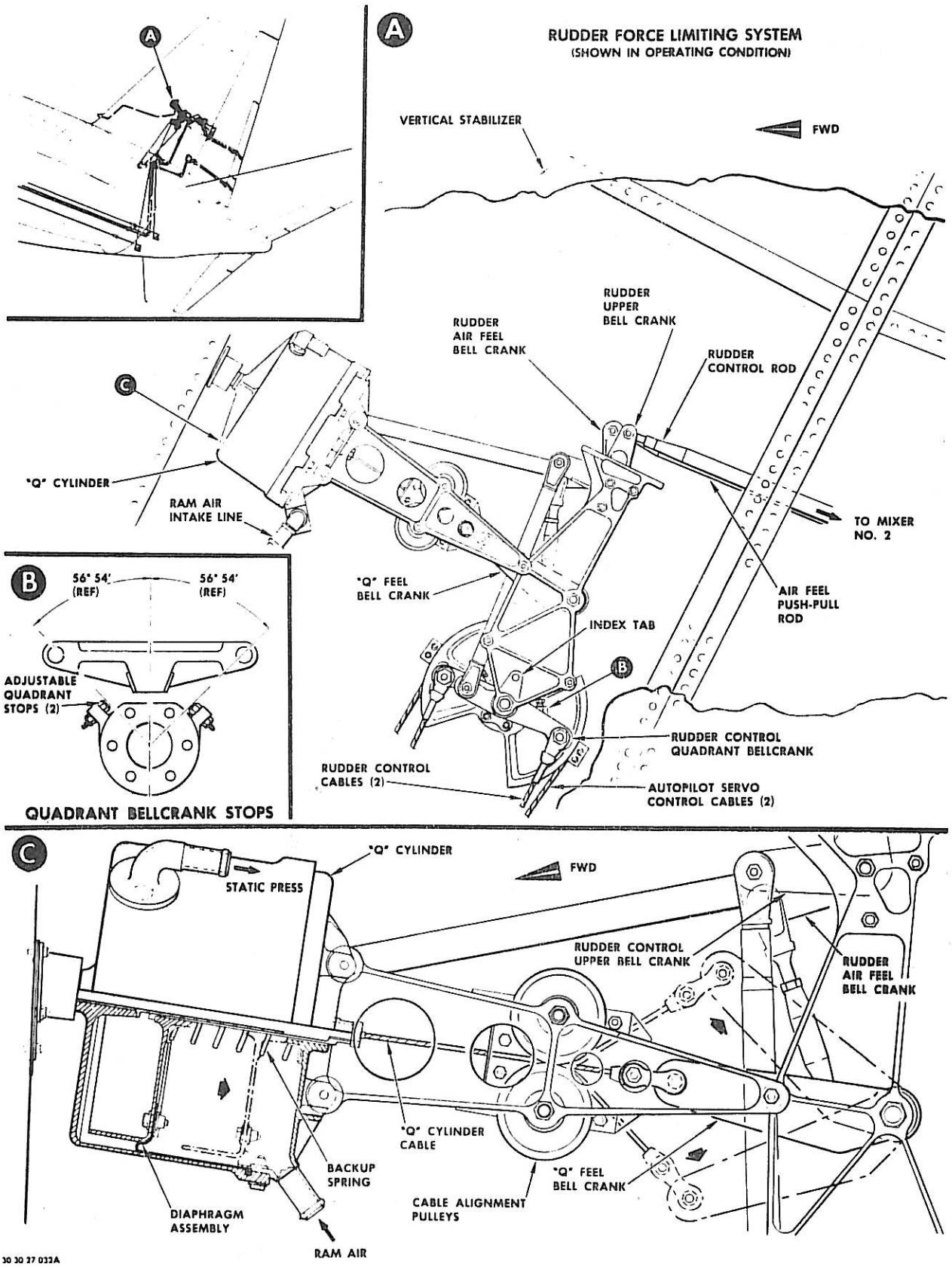
5. Rudder Feel System

The rudder feel system consists primarily of a "Q" cylinder installed in the vertical stabilizer, a "Q" feel bell crank installed between the rudder control quadrant and the rudder upper bell crank, and an air feel bell crank installed adjacent to the rudder upper bell crank. The "Q" cylinder is divided into a forward and an aft chamber by a piston which is sealed to the cylinder wall by a rolling curtain seal. The forward chamber is vented to ambient air pressure in the vertical stabilizer; the aft chamber is connected to a heated ram air inlet in the leading edge of the vertical stabilizer. A cable, connected to the "Q" cylinder piston, passes between two cable alignment pulleys and is connected to the "Q" feel bell crank. The other arm of the "Q" feel crank is connected, by a push-pull rod, to the air feel bell crank. The other arm of the air feel crank is connected, by a push-pull rod, to mixer No. 2 in the rudder control package. A spring in the aft chamber of the "Q" cylinder, behind the piston, maintains tension on the cable when the airplane is on the ground (see Figure 4).

In flight, ram air pressure builds up in the aft chamber of the "Q" cylinder and increases the tension of the cable attached to the piston. In the normal mode of rudder operation, movement of the control linkage displaces the "Q" feel bell crank from its rest position in line with the "Q" cylinder cable, the cable is bent around one of the alignment pulleys, and the piston is pulled back against ram air pressure. The ram air pressure in the "Q" cylinder exerts a restoring force on the "Q" feel bell crank proportional to linkage displacement. This provides an artificial feel force for the pilot. In the manual mode of operation, the artificial feel system is bypassed and rudder feel is transmitted from the flight tab to the rudder pedals.

6. Rudder Control Package

The rudder control package consists of the power mode trim jack, centering spring mechanism, mixer No. 1, mixer No. 2, power-to-manual reversion mechanism, hydraulic servo valve, and the flight tab control bell crank (see Figure 3). The control package is accessible from either side of the vertical stabilizer.


A
RUDDER FORCE LIMITING SYSTEM
(SHOWN IN OPERATING CONDITION)
VERTICAL STABILIZER
FWD
RUDDER UPPER BELL CRANK
RUDDER AIR FEEL BELL CRANK
RUDDER CONTROL ROD
C
"Q" CYLINDER
RAM AIR INTAKE LINE
TO MIXER NO. 2
"Q" FEEL BELL CRANK
INDEX TAB
AIR FEEL PUSH-PULL ROD
B
56° 54' (REF)
56° 54' (REF)
ADJUSTABLE QUADRANT STOPS (2)
QUADRANT BELLCRANK STOPS
RUDDER CONTROL QUADRANT BELLCRANK
RUDDER CONTROL CABLES (2)
AUTOPILOT SERVO CONTROL CABLES (2)
C
"Q" CYLINDER
STATIC PRESS
FWD
RUDDER CONTROL UPPER BELL CRANK
RUDDER AIR FEEL BELL CRANK
"Q" CYLINDER CABLE
BACKUP SPRING
"Q" FEEL BELL CRANK
CABLE ALIGNMENT PULLEYS
DIAPHRAGM ASSEMBLY
RAM AIR
30 30 27 033A

The power mode trim jack is cable operated through the manual rudder trim system and is connected to mixer No. 1. Actuation of the trim jack transmits motion to the hydraulic servo valve bell crank through the double bell crank in mixer No. 1. The rudder may be trimmed 6-1/2 (±1/4) degrees right or left of the streamlined position.

The centering spring mechanism consists of a roller in the end of a lever spring-loaded against a cam with two lobes in tandem. In normal mode of operation, movement of mixer No. 1 bell crank rotates the centering cam away from center and the roller rides up one of the cam lobes. Since spring loading on the roller causes the roller to seek the lowest point between the cam lobes, the cam is forced to rotate in the direction required to center the roller between the cam lobes as soon as input pedal force is removed from the system. When the cam returns to center, mixer No. 1 bell crank returns to center, the servo control valve is opened to port pressure to the actuators to return the rudder to neutral, and as the rudder returns to neutral the servo valve bell crank, pivoted off center on the rudder forward spar, closes the servo valve. The centering spring has no effect during manual mode operation.

Mixer No. 1 performs the power trim and centering functions. It consists of a double bell crank moving between two bell cranks pivoted on the upper and lower plates of the control package. Mixer No. 1 also controls the hydraulic servo valve through a spring-cartridge control rod (gust load override) connected to the servo valve bell crank and is, in turn, controlled by the output of mixer No. 2.

Mixer No. 2 consists of three bell cranks. The center bell crank is slotted to form a roller track and moves between two bell cranks pivoted on the upper and lower plates of the control package. The feel system connecting rod is attached at the midpoint of the center bell crank. The pilot's input connecting rod is attached at the LH end of the center bell crank. The effective pivot of the center bell crank is determined by the position of the power-to-manual reversion (lock-out) arm, the roller of which rides in the slotted track. The center bell crank pivots on its right end during power mode operation and pivots at mid-point during manual mode operation. In the power mode of operation, the output of mixer No. 2 is transmitted to mixer No. 1 through a connecting link. In the manual mode of operation, the output of mixer No. 2 is transmitted through push-pull rods to the flight tab bell crank.

The power-to-manual reversion mechanism controls the effective pivot point of the center bell crank of mixer No. 2 according to whether or not adequate hydraulic pressure is available for power mode of operation. The mechanism consists of two spring-loaded, single-action hydraulic actuators (lock-out cylinders) and a lock-out arm. A roller in the end of the arm rides in the slot in the center bell crank of mixer No. 2. When available hydraulic pressure is not adequate for rudder control, the control system is held in the manual mode by the return springs in the lock-out cylinders and an over-center lock in the reversion mechanism. A switch, actuated by the lock-out arm, causes a MANUAL MODE WARNING light to illuminate on the flight engineer's panel when the rudder control system is in manual mode. When normal hydraulic pressure is supplied to the rudder control system, the

lock-out cylinders are pressurized and extend to move the lock-out arm over to the power mode position. The system will remain in power mode position as long as hydraulic pressure in either system remains above 1000 psi. If pressure in both hydraulic systems drops to below 1000 psi, the spring-loaded lock-out cylinders will retract and the rudder control system will revert to manual mode of operation. When pressure in either hydraulic system increases to more than 1700 psi, the lock-out cylinders will extend, and the rudder control system will return to the power mode.

The rudder hydraulic servo control valve is installed in the aft end of the control package, just forward of the rudder hinge line. The valve controls hydraulic pressures up to 3000 psi from each of the airplane's two hydraulic systems. Hydraulic pressure from the servo valve is routed to the four rudder actuating cylinders, the lock-out cylinders, and to low pressure switches. The valve is actuated by the output from mixer No. 1 through a spring-cartridge control rod, the valve control bell crank, and a link connecting the bell crank to the valve. The valve control bell crank is mounted off-center on the rudder forward spar so that movement of the rudder moves the bell crank pivot point forward or aft to actuate the servo valve toward the closed position.

In the power mode of operation the servo valve directs hydraulic pressure to the pressure switches, the lock-out cylinders, and the rudder actuators. If hydraulic pressure falls to less than 1000 psi in both hydraulic systems, a "fuse" valve in the servo valve assembly opens and dumps pressure from switches, lock-out cylinders, and rudder actuators. The hydraulic pressure lines are closed by the pressure switches and solenoid-operated shutoff valves (refer to paragraph 10). The "fuse" valve remains in the open, or bypass, position until pressure in one hydraulic system rises to more than 1700 psi. When this pressure is reached, the "fuse" valve closes and the system changes over to the power mode of operation.

The flight tab bell crank is pivoted in the aft end of the control package. The bell crank is connected, by two push-pull rods, to the RH end of the center bell crank of mixer No. 2. In normal operation, the position of the lock-out arm prevents any fore and aft movement of the RH end of the mixer No. 2 bell crank and the flight tab bell crank is effectively locked in neutral position. In manual mode operation, the lock-out arm roller is in the LH end of the slotted track in the bell crank, the bell crank pivots on the roller, and the output of mixer No. 2 is transmitted to the flight tab bell crank.

7. Rudder Hydraulic Actuating Cylinders

The rudder is actuated, in power mode of operation, by four identical hydraulic actuating cylinders. Two of the actuating cylinders are installed near rudder hinge number five and two are installed just above rudder hinge number three. The hydraulic servo control valve directs hydraulic system No. 1 pressure to the upper right and lower left actuating cylinders. Hydraulic system No. 2 pressure operates the upper left and lower right actuating cylinders. When the airplane is on the ground with no pressure in either hydraulic system, the actuating cylinders act as gust dampers and mechanical stops.

8. Rudder

The rudder includes a flight tab and a trim tab and is attached to the vertical stabilizer by shear type bolts at six points. Balance curtains are installed between the rudder leading edge and the vertical stabilizer. These curtains reduce the rudder hinge moment and thereby assist rudder movement in the manual mode of operation. Refer to Chapter 55, STABILIZERS, for a description of the rudder structure.

9. Flight Tab

The flight tab extends nearly half the length of the rudder and is of all-aluminum, sandwich-type construction. Four hinges are provided to attach the flight tab to the rudder. Refer to Chapter 55, STABILIZERS, for a description of the flight tab structure.

10. Rudder Hydraulic Control System

In the power mode of operation, the rudder control system is powered by hydraulic systems No. 1 and No. 2. Hydraulic pressure is routed through a shutoff valve in each system and then to the rudder servo control valve (see Figure 2). The servo control valve directs hydraulic pressure from each hydraulic system to one power-to-manual reversion mechanism actuating (lock-out) cylinder, one low pressure switch, and two rudder hydraulic actuators. Two high-pressure relief valves and a normally-open solenoid-operated bypass shutoff valve are installed in bypass position between the pressure and return lines connecting the servo valve and each pair of actuators. When pressure in the actuating cylinders builds up to more than 1500 psi, the relief valves open to prevent further build-up of pressure in the cylinders. If operated at normal operating hydraulic pressure of 3000 psi, the four rudder actuating cylinders would be capable of inducing rudder deflections, at high airspeeds, beyond the structural limits of the airplane.

On the ground, sufficient force is developed to fully deflect the rudder and pressure builds up to more than 1500 psi only when the pistons bottom out in the actuating cylinders. In the air, aerodynamic forces tend to drive the deflected rudder to streamline position. These forces, acting against the pistons in the actuating cylinders, cause pressure in the cylinders to build up to more than 1500 psi before the rudder is fully deflected, the relief valves open to limit pressure, and the rudder cannot be further deflected. As airspeed increases, aerodynamic forces increase and less rudder deflection is obtained before the relief valves open. This force limiting system restricts the output of each pair of rudder actuators to one-half the output obtainable at full hydraulic system pressure.

If one hydraulic system fails, the remaining system reverts to normal pressure operation and full control effectiveness is retained. The maximum actuating force applied at the rudder in either condition is within the structural limits of the airplane.

11. Rudder Warning System

The shutoff switch installed in each hydraulic system is normally closed and is actuated to the open position when hydraulic system pressure reaches or exceeds 800 psi. The switch installed in hydraulic system No. 1 is connected electrically to the bypass shut-off valve in system No. 2; the switch installed in system No. 2 is connected to the valve in system No. 1 (see Figure 5). If hydraulic pressure in either hydraulic system falls to less then 800 psi, the low pressure switch in that system reverts to the closed position. When the low pressure switch closes, it closes the circuit to illuminate the applicable SYSTEM OFF light on the *flight engineer's panel (**copilot's instrument panel) and to energize the bypass shutoff valve in the other hydraulic system. The energized bypass valve is closed and allows no flow through the bypass relief valves in the operating system so that full system pressure is available to power the two rudder actuating cylinders in the operating hydraulic system. Thus, full power is available for rudder operation even though two rudder actuating cylinders are developing no power.

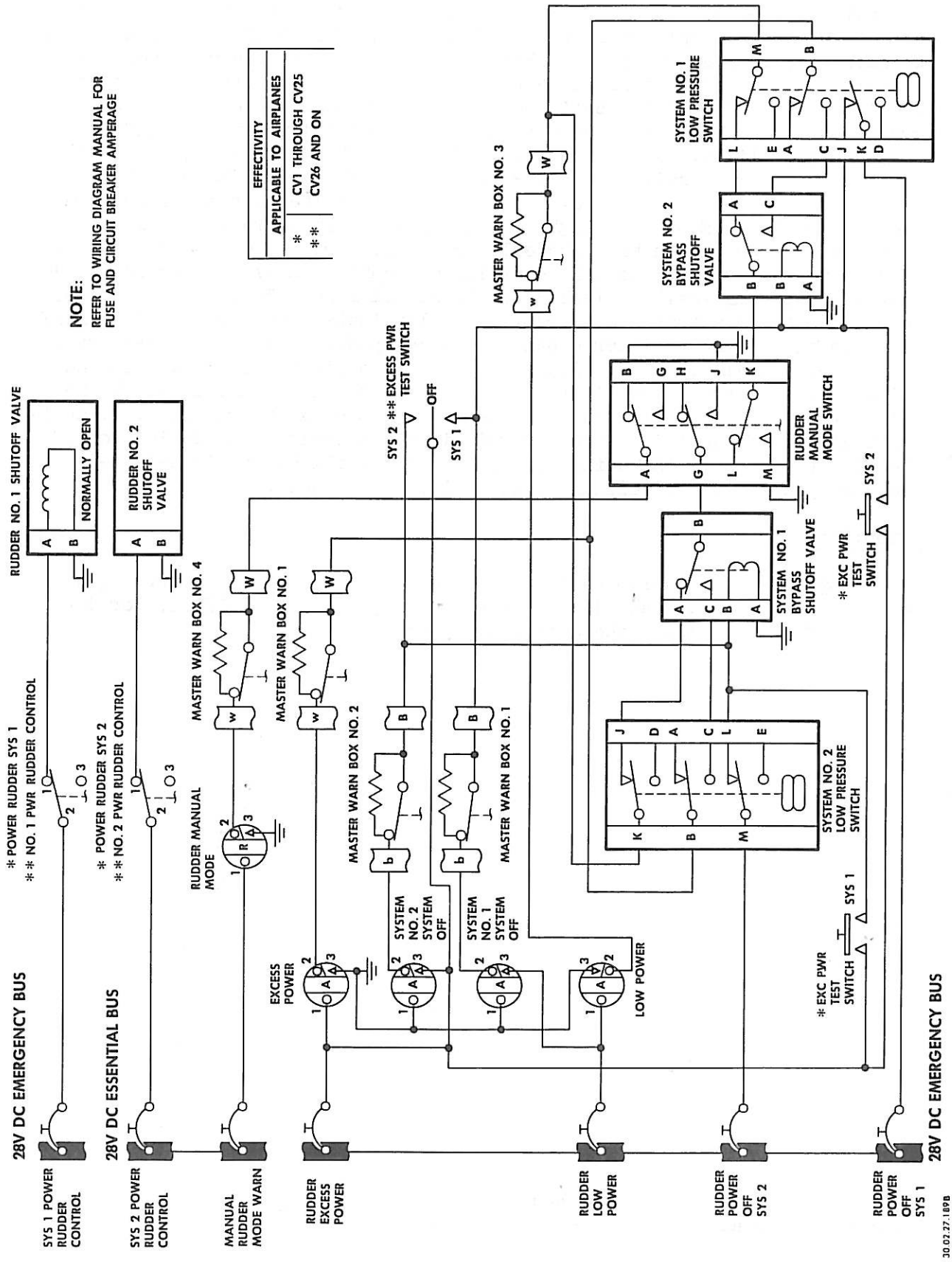
If a pressure switch closes due to loss of pressure in one hydraulic system and the bypass valve does not close in the other system, a circuit is completed through the switch and the valve to illuminate the LOW POWER light on the *flight engineer's panel (**copilot's instrument panel). This light indicates that the rudder control system is operating on half power since the bypass valve in the operating system did not close and the relief valves are still limiting the working pressure in the operating actuating cylinders.

When normal operating pressure in both hydraulic systems is regained, the closed pressure switch opens, breaking the circuit energizing the bypass valve in the other system, and the valve is allowed to open. The bypass relief valves then limit the pressure available at all rudder actuating cylinders.

If a bypass valve does not open when its controlling pressure switch opens, a circuit is completed through a switch in the bypass valve and through the pressure switch which illuminates the EXCESS POWER light on the *flight engineer's panel (**copilot's instrument panel). This light indicates that two rudder actuating cylinders are operating at full power (3000 psi) and two actuators are operating at half power (1500 psi). Operation of the rudder at high airspeeds under this condition could result in damage to airplane structure.

*A three-position EXCESS PWR TEST switch on the flight engineer's panel (**two EXC PWR TEST push-to-test switches on the copilot's instrument panel) is incorporated in the rudder warning system to check the EXCESS POWER warning light circuit with hydraulic pressure on rudder systems No. 1 and 2.

*Applicable to airplanes CV26 and on.
**Applicable to airplanes CV1 through CV25.


NOTE:
REFER TO WIRING DIAGRAM MANUAL FOR FUSE AND CIRCUIT BREAKER AMPERAGE
EFFECTIVITY
APPLICABLE TO AIRPLANES
* CV1 THROUGH CV25
** CV26 AND ON
RUDDER NO. 1 SHUTOFF VALVE
NORMALLY OPEN
RUDDER NO. 2 SHUTOFF VALVE
* POWER RUDDER SYS 1
** NO. 1 PWR RUDDER CONTROL
* POWER RUDDER SYS 2
** NO. 2 PWR RUDDER CONTROL
RUDDER MANUAL MODE
MASTER WARN BOX NO. 4
MASTER WARN BOX NO. 1
MASTER WARN BOX NO. 2
MASTER WARN BOX NO. 3
SYS 2 ** EXCESS PWR TEST SWITCH
OFF
SYS 1
SYSTEM NO. 1 LOW PRESSURE SWITCH
SYSTEM NO. 2 BYPASS SHUTOFF VALVE
RUDDER MANUAL MODE SWITCH
SYSTEM NO. 1 BYPASS SHUTOFF VALVE
* EXC PWR TEST SWITCH
SYS 2
SYSTEM NO. 2 LOW PRESSURE SWITCH
SYSTEM NO. 2 SYSTEM OFF
SYSTEM NO. 1 SYSTEM OFF
EXCESS POWER
LOW POWER
* EXC PWR TEST SWITCH
SYS 1
28V DC EMERGENCY BUS
28V DC ESSENTIAL BUS
28V DC EMERGENCY BUS
SYS 1 POWER RUDDER CONTROL
SYS 2 POWER RUDDER CONTROL
MANUAL RUDDER MODE WARN
RUDDER EXCESS POWER
RUDDER LOW POWER
RUDDER POWER OFF SYS 2
RUDDER POWER OFF SYS 1
30.02.27.189B

Actuating system No. 1 **EXC PWR TEST switch (*moving the EXCESS PWR TEST switch to SYS 1) completes a circuit through the RUDDER EXCESS POWER circuit breaker to illuminate SYSTEM 2 - SYSTEM OFF warning light and to actuate system No. 1 bypass shutoff valve to the off position. Actuating system No. 1 bypass shutoff valve positions a switch to complete a circuit to ground through the manual mode warning switch and illuminate the EXCESS POWER warning light. Actuating system No. 2 **EXC PWR TEST switch (*moving the EXCESS PWR TEST switch to SYS 2) causes SYSTEM 1 - SYSTEM OFF light to illuminate, actuates system No. 2 bypass shutoff valve to the off position and causes the EXCESS POWER light to illuminate. If hydraulic pressure drops below 1000 psi in both hydraulic systems, spring-loaded lock-out cylinders in the power-to-manual reversion mechanism are deactuated and rudder control is automatically switched to the manual mode. In the manual mode, the lock-out arm actuates a switch which illuminates the MANUAL MODE WARNING light on the flight engineer's panel. Rudder pedal movement is then transmitted mechanically, to the flight tab. Aerodynamic forces acting on the flight tab move the rudder in the opposite direction to that in which the flight tab has been deflected. As the rudder moves away from neutral, anti-servo action of the flight tab control linkage decreases the deflection of the flight tab until the deflecting force of the flight tab is balanced by the aerodynamic forces tending to streamline the rudder.

12. Autopilot

The autopilot rudder servo cables are attached to the rudder control quadrant in the vertical stabilizer. Refer to Chapter 22, AUTOPILOT, for detailed information about the autopilot system.

*Applicable to airplanes CV26 and on.
**Applicable to airplanes CV1 through CV25.

RUDDER CONTROL SYSTEM -- TROUBLE SHOOTING

POSSIBLE CAUSE	ISOLATION PROCEDURE AND CORRECTION
1. EXCESSIVE FORCE REQUIRED TO MOVE RUDDER FLIGHT TAB IN MANUAL MODE	
A. Improper control cable tension.	Check tension of rudder control cables. If tension is not correct, adjust as required (refer to Adjustment/Test Rudder Control System Rigging Procedure).
B. Excessive friction in control cable bell cranks or rudder pedal arms.	Disconnect lower end of vertical control rod, between rudder control quadrant and rudder upper bell crank, from control quadrant bell crank and actuate rudder pedals to check for excessive resistance. If rudder pedals move freely, trouble is beyond rudder cable system. If rudder pedals do not move freely, disconnect four control rods from bottoms of rudder pedal arms and actuate rudder pedals to check for excessive resistance. If all four rudder pedals move freely, relieve rudder cable system tension by loosening turnbuckle in one rudder cable and check rudder control bell cranks individually for freedom of movement. Repair or replace defective parts as required. If one rudder pedal does not move freely, disassemble defective pedal assembly and repair or replace defective parts.
C. Excessive friction in flight tab hinges.	If rudder pedals and cable system move freely, disconnect flight tab control rods from flight tab bell crank in rear of control package. Manually actuate flight tab and check for excessive resistance. Repair or replace defective parts as required.
D. Excessive friction in feel system.	If flight tab moves freely, disconnect control rods between control package and rudder upper bell crank and rudder air feel bell crank. Check bell cranks and feel system for excessive resistance. Repair or replace parts as indicated.

POSSIBLE CAUSE	ISOLATION PROCEDURE AND CORRECTION
1. EXCESSIVE FORCE REQUIRED TO MOVE RUDDER FLIGHT TAB IN MANUAL MODE (CONT)	
E. Excessive friction in rudder control package.	If bell cranks and feel system move freely, defect is in control package. Replace control package.
2. RUDDER CONTROL SYSTEM JAMMED	
a. Interference from foreign object	Isolate jammed part as outlined for isolating excessive friction point in trouble No. 1. Remove foreign object and repair or replace damaged parts as required.
B. Interference with structure or other parts due to faulty installation.	Locate defect as outlined for trouble No. 1. Correct installation; repair or replace parts as required.
3. RUDDER FLIGHT TAB DOES NOT RETURN TO STREAMLINE POSITION AFTER RUDDER ACTUATION IN POWER MODE	
A. Rudder trim knob not set at zero trim.	Set rudder trim knob, on pilot's pedestal, at zero trim.
B. Flight tab control rods not adjusted to correct length.	Adjust control rods (refer to Adjustment/Test Rudder Control System Rigging Procedure).
C. Rudder does not return to center.	Refer to trouble No. 4.
4. RUDDER DOES NOT RETURN TO CENTER AFTER POWER ACTUATION	
A. Centering spring mechanism connecting link not properly adjusted.	Disconnect lock-out arm from actuating linkage. Swing arm between extremes of travel in roller track. Adjust centering spring connecting link to obtain minimum motion of slotted bell crank when lock-out arm is moved from one end of the track to the other.
B. Servo valve link not properly adjusted.	Adjust servo valve connecting link (refer to Adjustment/Test Rudder Control System Rigging Procedure).
C. Excessive friction in rudder control system.	Refer to trouble No. 1.
D. Rudder trim control not set at zero trim.	Set rudder trim control, on pilot's pedestal, at zero trim.

POSSIBLE CAUSE	ISOLATION PROCEDURE AND CORRECTION
4. RUDDER DOES NOT RETURN TO CENTER AFTER POWER ACTUATION (CONT)	
E. Rudder control package defective.	Replace control package. (Refer to Removal/Installation Rudder Control Package).
F. Faulty installation of rudder, rudder actuators, or servo valve bell crank.	Check and correct installations. Refer to applicable removal and installation instructions.
5. RUDDER DOES NOT OPERATE WITH HYDRAULIC PRESSURE IN ONE OR BOTH HYDRAULIC SYSTEMS	
A. Rudder hydraulic shutoff valves energized closed.	Open *POWER RUDDER - SYS 1 and SYS 2 switches on copilot's instrument panel (**NO. 1 and NO. 2 PWR RUDDER CONTROL switches on flight engineers panel).
B. Servo valve bell crank disconnected.	Connect bell crank and adjust valve link (refer to Adjustment/Test Rudder Control System Rigging Procedure).
C. Hydraulic lines incorrectly connected to one or more actuating cylinders.	Check hydraulic connections and make required corrections.
D. Rudder control linkage disconnected forward of control package.	Check linkage and make necessary connections
E. Lock-out cylinders not connected hydraulically or linkage not connected.	Check control package and make required connections.
6. RUDDER PEDALS DO NOT CENTER PROPERLY AFTER ACTUATION IN POWER MODE	
A. Excessive friction in rudder control linkage.	Refer to trouble No. 1
B. Centering spring cam incorrectly positioned.	Adjust centering spring mechanism connecting link as outlined in trouble No. 4. If adjustment does not correct malfunction, replace control package.
C. Control cables not properly adjusted.	Check and adjust control cables as required (refer to Adjustment/Test Rudder Control System Rigging Procedure).

*Applicable to airplanes CV1 through CV25.
**Applicable to airplanes CV26 and on.

POSSIBLE CAUSE	ISOLATION PROCEDURE AND CORRECTION
7. RUDDER MOVES TO AND REMAINS IN FULLY DEFLECTED POSITION	
A. Servo valve link disconnected.	Adjust and connect servo valve link (refer to Adjustment/Test Rudder Control System Rigging Procedure).
8. FLIGHT TAB MOVES IN SERVO DIRECTION WITH HYDRAULIC PRESSURE IN SYSTEM AND RUDDER DEFLECTION LIMITED TO HALF TRAVEL	
A. Lock-out mechanism jammed or disconnected.	Check lock-out mechanism. Make necessary connections or correct cause of jam.
9. MANUAL MODE LIGHT DOES NOT EXTINGUISH WITH EITHER POWER RUDDER CONTROL SWITCH IN "ON" POSITION	
A. Faulty power rudder control switch.	Check continuity through switch in ON position and replace if necessary.
B. Faulty rudder manual mode switch.	Check continuity through pins A and B with switch plunger depressed. If continuity, replace switch.
C. Faulty master warning box No. 4	Check continuity through pins w and W. If no continuity, replace box.
10. ASSOCIATED SYSTEM "OFF" LIGHT DOES NOT EXTINGUISH WHEN POWER RUDDER CONTROL SWITCH IS ACTUATED TO "ON" POSITION	
A. Faulty power rudder control switch.	Check continuity through switch in ON position and replace if necessary.
B. Faulty associated low pressure switch.	Check continuity through pins J and K on system No. 1 switch or pins L and M on system No. 2 switch. If continuity with hydraulic pressure on, replace switch.
C. Faulty associated system shutoff valve.	Check for audible click of solenoid; if valve does not click, replace valve.
11. ASSOCIATED SYSTEM "OFF" LIGHT DOES NOT ILLUMINATE WHEN POWER RUDDER CONTROL SWITCH IS ACTUATED TO "OFF" POSITION	
A. Faulty power rudder control switch.	Check continuity through switch in OFF position and replace if necessary.
B. Faulty associated circuit breaker or circuit breaker open.	Check continuity through closed circuit breaker and replace if no continuity.

POSSIBLE CAUSE	ISOLATION PROCEDURE AND CORRECTION
11. ASSOCIATED SYSTEM "OFF" LIGHT DOES NOT ILLUMINATE WHEN POWER RUDDER CONTROL SWITCH IS ACTUATED TO "OFF" POSITION (CONT)	
C. Faulty *dim relay box No. 9 (**master warning Box No. 2).	Check continuity through pins *t and T (**b and B). If no continuity, replace box.
D. Faulty associated low pressure switch.	Check continuity through pins L and M on system No. 1 pressure switch or pins J and K on system No. 2 switch. Replace switch if no continuity with hydraulic pressure off.
E. Faulty associated system shutoff valve.	Check for audible click of solenoid when switch is actuated; if valve does not click, replace valve.
12. LOW POWER LIGHT DOES NOT ILLUMINATE WHEN SYSTEM NO. 1 OR NO. 2 IS OFF AND OPPOSITE SYSTEM IS AT NORMAL PRESSURE	
NOTE: Trouble No. 12 is simulated by actuating system No. 1 or No. 2 control switch to OFF position and opening same system RUDDER POWER OFF circuit breaker.	
A. Faulty RUDDER LOW POWER circuit breaker or circuit breaker not closed.	Check continuity through closed circuit breaker and replace if necessary.
B. Faulty power rudder control switch	Check continuity through switch in OFF position. If no continuity, replace switch.
C. Faulty *dim relay box No. 9 (**master warning box No. 3).	Check continuity through pins *n and N (**w and W). If no continuity, replace box.
D. Faulty associated system low pressure switch.	Check continuity through pins L and M on system No. 1 pressure switch or pins J and K on system No. 2 switch. If no continuity, replace switch.
E. Faulty associated bypass shutoff valve switch.	Check for continuity through pins A and B at associated bypass valve switch. If no continuity, replace switch.

*Applicable to airplanes CV1 through CV25.
**Applicable to airplanes CV26 and on.

POSSIBLE CAUSE	ISOLATION PROCEDURE AND CORRECTION
12. LOW POWER LIGHT DOES NOT ILLUMINATE WHEN SYSTEM NO. 1 OR NO. 2 IS OFF AND OPPOSITE SYSTEM IS AT NORMAL PRESSURE (CONT)	
F. Faulty manual rudder mode switch.	Check for continuity through pins G and J for system No. 1 or pins K and M for system No. 2. Replace switch if no continuity with switch plunger depressed.
13. EXCESS POWER LIGHT DOES NOT ILLUMINATE WHEN TEST SWITCH IS ACTUATED	
A. Low hydraulic pressure in system being checked.	Refer to Chapter 29, HYDRAULIC POWER.
B. Faulty RUDDER EXCESS POWER circuit breaker or circuit breaker open.	Check continuity through closed circuit breaker and replace if no continuity.
C. Faulty excess power test switch.	Check continuity through switch in ON position and replace if no continuity.
D. Faulty *dim relay box No. 9 (**master warning box No. 1).	Check continuity through pins *p and P (**w and W). If no continuity, replace box.
E. Faulty system No. 1 or No. 2 low pressure switch.	Check continuity through pins B and C on system No. 1 or No. 2 pressure switch. If no continuity replace switch.
F. Faulty system No. 1 or No. 2 bypass shutoff valve or switch.	Check continuity through pins A and B on valve and pins B and C on switch. If no continuity, replace switch or valve. If continuity, check for audible click of solenoid when test switch is actuated; if valve does not click, replace valve.
G. Faulty rudder manual mode switch.	Check continuity through pins K and M for system No. 1 or pins G and J for system No. 2 when switch plunger is depressed. If no continuity, replace switch.

*Applicable to airplanes CV1 through CV25.
**Applicable to airplanes CV25 and on.

1. Adjustment/Test Rudder Control System Rigging Procedure (see Figure 201)

A. Rudder and Rudder Flight Tab Travel Data (see Figure 202).

Angular measurements are taken with a protractor installed on the trailing edge of the control surface or the flight tab. A linear measurement is the straight line distance, in inches, between the noted point on the surface in the streamline position and the same point on the surface in the deflected position.

B. Equipment Required.

(1) Stand suitable for reaching both sides of the rudder and vertical stabilizer.

(2) Tool 30-15000-901 RGTL #1 for streamlining rudder with vertical stabilizer and for measuring rudder deflection (see Figure 203).

(3) Tool 30-15000-901 RGTL #2 for streamlining rudder flight tab with rudder and for measuring flight tab deflection (see Figure 203).

(4) Deleted.

(5) Index pins as follows:

Two pins 22-J107-3.0

Four pins 22-J107-5.0

Two pins 22-J107-8.0

(6) Specially calibrated tensiometer for measuring tension of 1/8-inch x 1 x 19 non-flex control cable.

(7) Thermometer.

(8) Six-inch scale.

(9) External source of hydraulic power.

(10) External source of electric power.

(11) Source of dry, filtered air, or nitrogen to deliver pressures up to 15 inches Hg. Pressure source shall be equipped with "T" adapter to attach pressure source and mercury manometer to "Q" intake in vertical stabilizer.

C. Preparation.

(1) Make sure that rudder is clear of obstructions and personnel and that rudder travel will be unrestricted.

(2) Make sure that rudder, rudder flight tab, and rudder trim tab are free of locking devices, except as specifically listed in the following procedures.

(3) If airplane hydraulic system, or systems, are pressurized, make sure that rudder hydraulic shutoff valves are closed.

CAUTION: RUDDER HYDRAULIC SHUTOFF VALVES ARE NORMALLY OPEN AND WILL NOT CLOSE UNLESS ELECTRICAL SYSTEM IS ENERGIZED.

(4) If electrical system is not energized, connect external electric power source and energize electrical system (refer to Chapter 24, ELECTRIC POWER).

(5) Close SYS 1 and SYS 2 POWER RUDDER CONTROL circuit breakers on main circuit breaker panel and actuate *POWER RUDDER - SYS 1 and SYS 2 switches on copilot's instrument panel (**NO. 1 and NO. 2 PWR RUDDER CONTROL switches, on flight engineer's panel) to OFF position. Tape switches to OFF and hang warning tags on switches and circuit breakers if hydraulic system is pressurized, or if hydraulic system may be pressurized during rigging and adjustment of rudder control system.

D. Adjust Rudder Pedals.

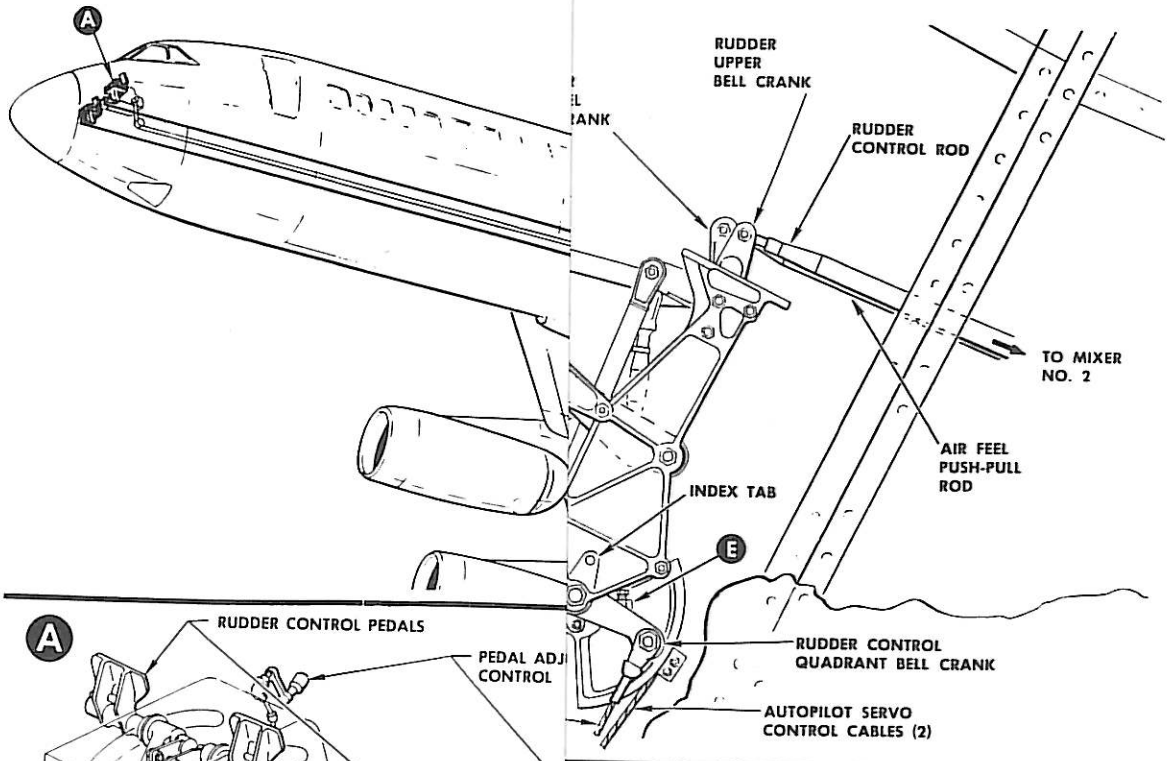
(1) Position rudder pedals so that index pin 22-J107-5.0 can be inserted through LH rudder forward bell crank.

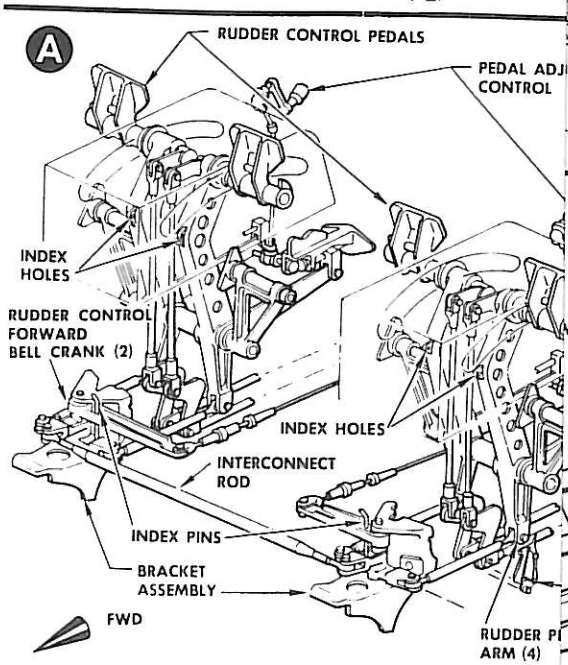
(2) Check alignment of index pin holes in rudder RH forward bell crank. If holes are aligned, insert index pin 22-J107-5.0 in rudder RH forward bell crank.

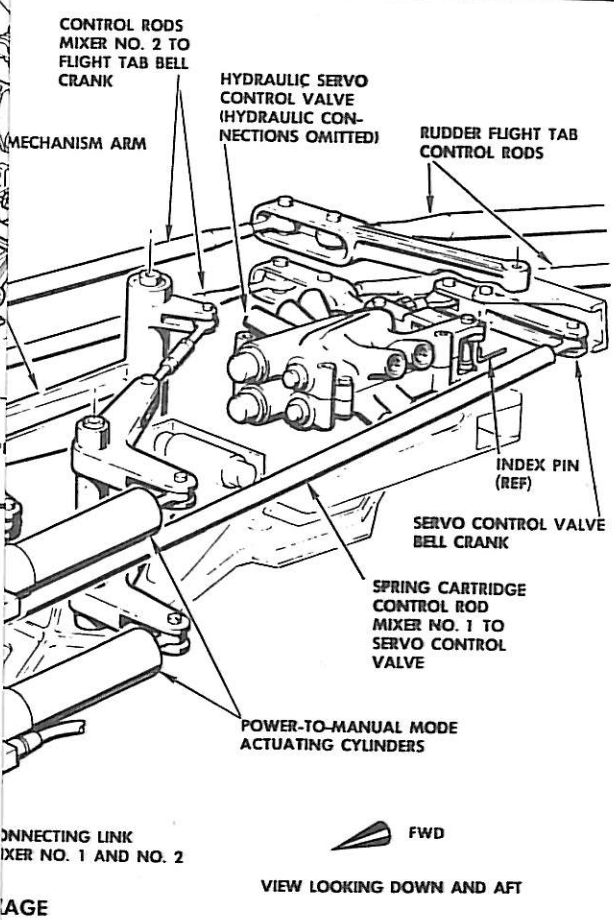
(3) If index pin holes in rudder RH forward bell crank are not aligned, relieve tension in rudder control cables and disconnect crossover tube from rudder RH forward bell crank. Adjust crossover tube to distance between rigged bell cranks, tighten lock nut, and install free end of rod on rudder RH forward bell crank.

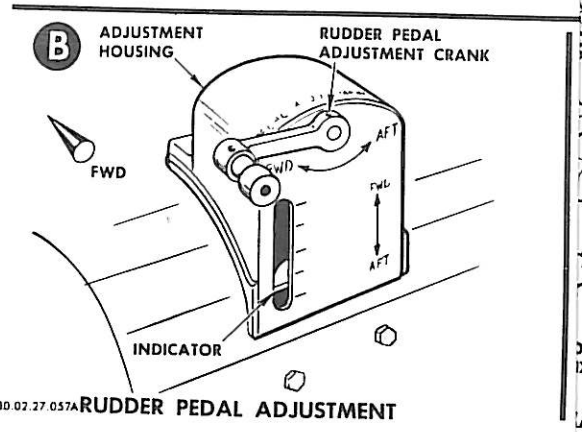
(4) Rotate each rudder pedal adjustment crank so that center of screw adjustment nut is 1.77 inches from aft face of aft leg of casting that supports screw.

*Applicable to airplanes CV1 through CV25.
**Applicable to airplanes CV26 and on.

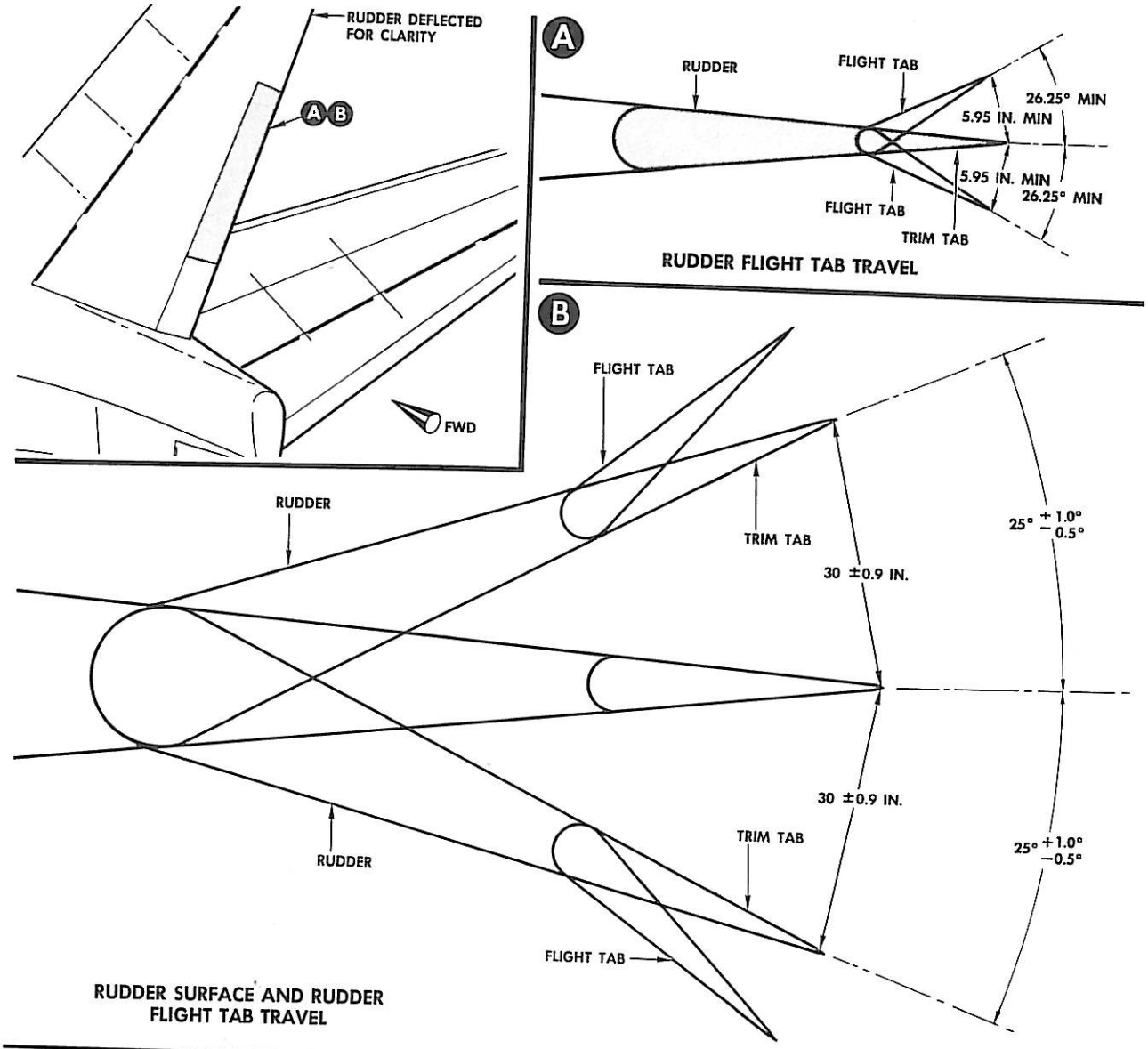








30.02.27.057A RUDDER PEDAL ADJUSTMENT

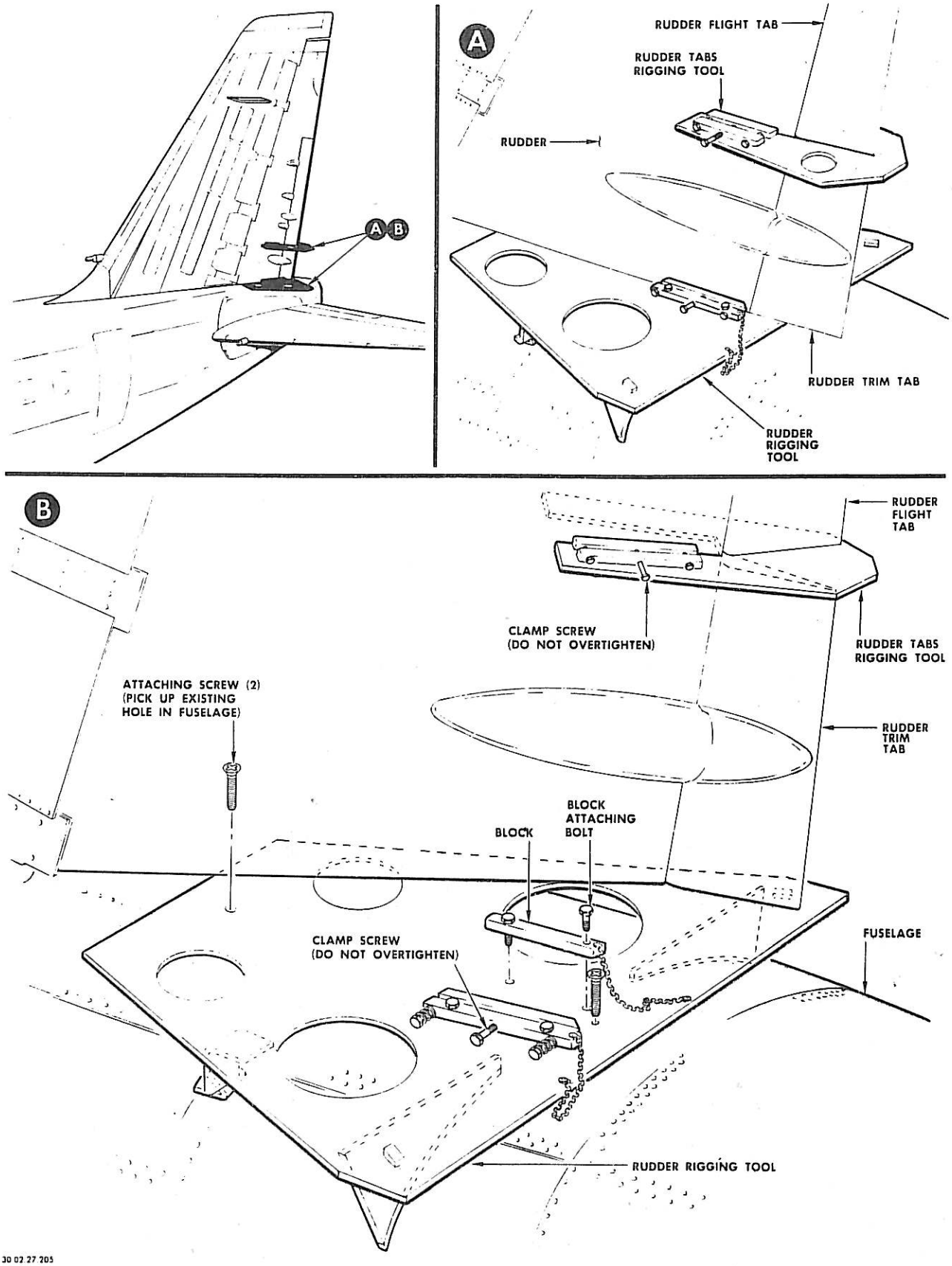


RUDDER SURFACE AND RUDDER FLIGHT TAB TRAVEL

	ANGULAR DEFLECTION		LINEAR DEFLECTION		LOCATION OF POINT ON SURFACE FOR DETERMINING LINEAR MEASUREMENTS
	LEFT	RIGHT	LEFT	RIGHT	
RUDDER	25° +1.0° −0.5°	25° +1.0° −0.5°	30 ±0.9 INCH	30 ±0.9 IN.	SEE NOTE 1
RUDDER FLIGHT TAB	26.25° MIN	26.25° MIN	5.95 INCH (MINIMUM)	5.95 INCH (MINIMUM)	SEE NOTE 2

NOTE 1 RUDDER
MAKE A MARK ON FUSELAGE AT CENTER LINE BELOW TRAILING EDGE OF TRIM TAB. LINEAR MEASUREMENT TAKEN BETWEEN CENTER POINT ON FUSELAGE AND SAME RELATIVE POINT ON TRIM TAB WHEN RUDDER IS DEFLECTED.

NOTE 2 RUDDER FLIGHT TAB
LINEAR MEASUREMENT IS TAKEN BETWEEN CENTER POINT OF FLIGHT TAB LOWER TRAILING EDGE AND CENTER POINT OF TRIM TAB UPPER TRAILING EDGE.



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Rudder, Rudder Flight Tab and Rudder Trim Tab Rigging Tools Installation
Figure 203

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(5) Remove pedestal side access panels and check alignment of index pin holes through rudder pedal arms. If holes are aligned, rods connecting rudder pedal arms and rudder forward bell cranks are adjusted correctly.

(6) If index pin hole in either or both sets of rudder pedal arms are not aligned, disconnect corresponding rod, insert index pin, adjust to distance between rigged rudder pedal arm and forward bell crank, tighten lock nut, and reinstall rod. Remove index pins from rudder pedal arms and replace pedestal side access panels.

E. Adjust Rudder Cables.

(1) With index pins 22-J107-5.0 installed in rudder control forward bell cranks, adjust tension of rudder control cables to a tension of 180 (±10) pounds at 70 degrees F (21 degrees C). Increase or decrease specified cable tension 1.0 pound for each degree F (2.0 pounds for each degree C) increase or decrease respectively in free air temperature.

(2) Assess misalignment of index pin holes at rudder control aft bell cranks, in tail cone, and rudder control idler bell cranks, in vertical stabilizer.

(3) Counting turnbuckle turns required, loosen turnbuckle on appropriate side of any indexing point enough to halve misalignment. Tighten turnbuckle on other side of indexing point an equal number of turns. Continue adjustment until index pins can be inserted through bell cranks. Use index pin 22-J107-5.0 to rig rudder control aft bell cranks and index pins 22-J107-3.0 to rig rudder control idler bell cranks.

(4) Repeat index point alignment, step (3), for each of remaining three bell cranks.

(5) Recheck cable tension. Adjust turnbuckles as required to obtain tension specified in step (1) with all index holes aligned as in steps (2) through (4).

(6) With index pins 22-J107-3.0 installed in rudder control idler bell cranks, align rudder control quadrant bell crank by alternately loosening and tightening opposing attached rudder cables until index pin 22-J107-3.0 can be inserted through index tab provided on quadrant.

(7) Remove all index pins and recheck cable tension. Readjust as required.

(8) Adjust power stops on rudder control quadrant to allow approximately 44° 44' rotation each way from neutral. Adjust power stops by installing, or removing, 0.063 washers under heads of stop bolts.

(9) Safety lock all cable turnbuckle with NAS 651 clips.

F. Adjust Rudder Control Package Connections.

(1) Install index pins 22-J107-5.0 in rudder control forward bell cranks.

(2) Install tool 30-15000-901 RGTL #1 and secure rudder in streamline position (see Figure 203).

(3) Remove second section, from bottom, of stabilizer aft vertical access panel.

(4) Open No. 1 and No. 2 shroud doors and No. 1 and No. 2 hinge support access doors on right side of vertical stabilizer and No. 2 shroud door on left side. Remove access panel from each side of stabilizer at rudder hinge point No. 3. Remove rudder hinge fairing plate and rudder hinge point No. 3.

(5) Disconnect lock-out cylinders from lock-out arm in control package. Swing lock-out arm to RH end of track slot.

(6) Connect dry air source to "Q" intake in vertical stabilizer and pressurize "Q"-cylinder to approximately 10 inches Hg. Adjust length of horizontal control rod to distance between rudder upper bell crank and attach point on mixer No. 2 center bell crank. Make sure that centering spring mechanism remains centered while rod is being connected. Make sure that vertical control rod from control quadrant bell crank is properly connected to other arm of upper bell crank and that index pin 22-J107-3.0 is installed in rudder control quadrant bell crank.

(7) With short control rod installed to connect "Q" feel bell crank and rudder air feel bell crank, adjust second horizontal control rod to distance between upper arm of air feel bell crank and LH end of mixer No. 2 center bell crank. Centering spring must remain centered when control rod is connected.

(8) With servo valve bell crank pivot bolt installed on forward side of rudder leading edge spar, disconnect control rod extending from bell crank to LH end of mixer No. 1 bell crank. Adjust rod to nominal length of 25 inches. Disconnect servo valve link from other end of servo valve bell crank. Adjust link, and control rod if necessary, so that a 3/32 inch diameter index pin can be freely inserted in the servo valve. Tighten jam nuts on link and control rod, make sure that both are properly connected, and recheck fit of index pin. Pin must be easily inserted and removed from servo valve without disturbing position of centering spring mechanism.

(9) Install tool 30-15000-901 RGTL #2 to measure rudder flight tab deflection (see Figure 203).

(10) Adjust length of flight tab control rods to obtain indication of zero flight tab deflection on tool.

(11) Make sure that ends of power trim jack cables are even. Connect cables into trim cable system in fuselage tail cone.

(12) Adjust tension of power trim cables (refer to Adjustment/Test Rudder Trim System Rigging Procedure).

(13) After adjusting rudder trim cables, insert 3/32 inch diameter index pin into index holes in servo valve. Pin must fit easily in index holes. Make sure that pilot's trim knob is set at zero, and, if necessary, adjust trim cables as required to obtain free fit of index pin in servo valve. Remove index pin and secure turnbuckles with NAS651 clips.

(14) Release rudder by removing rudder clamping blocks from tool 30-15000-901 RGTL #1. Remove all index pins from rudder control system.

(15) Connect lock-out cylinders to lock-out arm in control package. Lock-out arm will be in manual mode position.

G. Adjust Rudder Control System Under Hydraulic Power.

(1) Make sure that all index pins have been removed from rudder control system and that rudder is free to move. Clear rudder travel area and make sure that control system can be operated freely without evidence of interference or binding between limits set by power stops on rudder control quadrant.

(2) Connect external hydraulic power source to airplane and slowly pressurize hydraulic system No. 1 (refer to Chapter 29, HYDRAULIC POWER). Rudder surface shall center and reversion (lock-out) mechanism arm shall swing to normal (power) mode position when hydraulic pressure exceeds 1800 (±100) psi.

NOTE: If hydraulic systems have been pressurized during prior adjustment procedures, with *POWER RUDDER - SYS 1 and SYS 2 (**NO. 1 and NO. 2 PWR RUDDER) control switches in the OFF positions, hydraulic systems must be depressurized as outlined in Chapter 12, SERVICING, and slowly repressurized after moving *POWER RUDDER - SYS 1 and SYS 2 (**NO. 1 and NO. 2 PWR RUDDER) control switches to the ON positions.

(3) Slowly depressurize hydraulic system No. 1 (refer to Chapter 12, SERVICING). Lock-out arm shall swing to manual mode position when pressure decreases to less than 1000 (±100) psi and rudder shall be free to swing manually.

(4) Slowly pressurize hydraulic system No. 2 and repeat steps (2) and (3).

*Applicable to airplanes CV1 through CV25.
**Applicable to airplanes CV26 and on.

(5) Pressurize both hydraulic systems (refer to Chapter 29, HYDRAULIC POWER).

(6) Set rudder trim knob at zero degrees. Check position of rudder. Rudder shall be within 0.25 degree of neutral. If the action of the centering spring does not properly center rudder, note amount and direction of deflection, relieve hydraulic pressure (refer to Chapter 12, SERVICING), or close *POWER RUDDER - SYS 1 and SYS 2 (**NO. 1 and NO. 2 PWR RUDDER) control switches and adjust length of control rod between servo valve bell crank and mixer No. 1 by threading rod ends into or out of ends of control rod. Shorten rod about one-half turn of rod end to move rudder to left approximately 0.25 degree; lengthen control rod one-half turn of rod end to move rudder to right approximately 0.25 degree.

(7) Pressurize both hydraulic systems and note new neutral position of rudder. Repeat adjustment outlined in step (6) until rudder centers within 0.25 degree of neutral.

(8) Move rudder pedals slowly through full travel in either direction to engage stops on rudder control quadrant. Hold stop in contact and check rudder surface deflection. Depress opposite rudder pedal and check rudder deflection. Deflection shall be 25 (±0.50) degrees in each direction. If necessary, adjust power stops on rudder control quadrant to obtain required rudder deflection. Note actual rudder deflection in each direction.

(9) Depressurize hydraulic systems (refer to Chapter 12, SERVICING) or close *POWER RUDDER - SYS 1 and SYS 2 (**NO. 1 and NO. 2 PWR RUDDER) control switches.

(10) Move rudder manually in each direction and adjust rod ends of rudder actuating cylinders as required to provide mechanical rudder stops between 0.25 and 0.50 degree beyond deflection limits noted in step (8).

(11) Make sure that rudder actuating cylinders bottom out only in tension and that both cylinders on each side bottom out simultaneously. After adjustment, tighten and lockwire jam nuts on cylinder rod ends.

(12) Remove rigging tools from rudder and disconnect external hydraulic power source.

H. Adjust Autopilot Rudder Servo Cables.

(1) Check that clockwise rotation of servo drum, looking into face of drum, causes rudder surface to deflect left and flight tab to deflect right.

*Applicable to airplanes CV1 through CV25.
**Applicable to airplanes CV26 and on.

(2) Tighten turnbuckles in autopilot rudder servo cables until tension is 105 (±10.0) pounds at free air temperature of 70 degrees F (21 degrees C). Increase or decrease specified cable tension 0.50 pounds for each degree F (1.0 pound for each degree C) increase or decrease respectively in free air temperature.

(3) Safety turnbuckles with NAS 651 clips.

I. Adjust Rudder Pedal Stops.

(1) Adjust rudder pedal stops at rudder control forward bell cranks to allow maximum forward rudder pedal travel of 3.87 (±0.06) inches from neutral. This travel may be achieved only by contacting quadrant bell crank stops and then applying sufficient pedal force to stretch cable system up to pedal stops.

2. Adjustment/Test Rudder Control System Functional Test

A. Equipment Required.

(1) Stand suitable for reaching both sides of rudder and vertical stabilizer.

(2) Tool 30-15000-901 RGTL #1 for streamlining rudder with vertical stabilizer and for measuring rudder deflection.

(3) Tool 30-15000-901 RGTL #2 for streamlining rudder flight tab with rudder and for measuring flight tab deflection.

(4) Tool 22-04304TSTO-P to measure force required to turn rudder trim knob.

(5) Specially calibrated tensiometer for measuring tension of 1/8 x 1 x 19 nonflex control cables.

(6) Standard cable tensiometer.

(7) Thermometer.

(8) Six-inch scale.

(9) Spring scale with 20 pounds capacity calibrated in 0.1 pound intervals with adapters for attaching scale to trailing edge of rudder and flight tab, and gust lock handle.

(10) External source of hydraulic power.

(11) External source of electrical power.

(12) Source of dry filtered air or nitrogen to deliver pressure up to 15 inches Hg. Pressure source shall be equipped with "T" adapter to attach pressure source and mercury manometer to "Q" intake in vertical stabilizer. Pressure source to be capable of maintaining pressure in "Q" cylinder at 1.17 (±0.10) inches Hg throughout rudder travel.

B. Pre-operational Checks.

(1) Make sure that rudder hydraulic system is not pressurized. Relieve hydraulic system pressure or move power rudder control switches to OFF position.

NOTE: Power rudder control switches are ineffective if POWER RUDDER CONTROL circuit breakers are open or if the airplane electrical system is not energized.

(2) Before operating rudder control system, clear rudder area of any obstruction that may interfere with rudder travel. Release or remove all rudder, rudder flight tab, and rudder trim tab locking devices.

(3) Inspect all fairleads, pulleys, cable drums, cable guards, quadrants, bell cranks, terminals, pressure seals, turnbuckles, "Q" cylinder, rudder control package, etc. for proper installation.

(4) Check lock nuts for proper torque, proper installation of safety wire where required, and turnbuckles for proper installation of locking clips.

(5) Manually position rudder at 14 (±1.0) degrees LH deflection and slowly depress LH rudder pedal through full travel. Check that all rudder components clear surrounding structure throughout full travel of rudder pedal.

(6) Slowly release LH rudder pedal, manually position rudder at 14 (±1.0) degrees RH deflection, and slowly depress RH rudder pedal through full travel. Check that all rudder components clear surrounding structure throughout full travel of rudder pedal.

(7) Return rudder and rudder pedals to neutral position.

(8) Using specially calibrated tensiometer, check that tension of rudder cables is 180 (±10) pounds at 70 degrees F (21 degrees C). Increase or decrease specified cable tension 1.0 pound for each degree F (2.0 pounds for each degree C) increase or decrease respectively in free air temperature.

(9) Using standard tensiometer, check that tension of forward trim cables is 150 (±9.0) pounds at 70 degrees F (21 degrees C). Increase or decrease specified cable tension 0.5 pound for each degree F (1.0 pound for each degree C) increase or decrease respectively in free air temperature.

(10) Above point at which trim cables separate in tail cone, equalize tension of manual trim jack and power trim jack cable loops to within 10 pounds by loosening one cable loop and tightening the other cable loop an equal number of turnbuckle turns. Recheck tension of rudder forward trim cables and adjust as necessary.

(11) Using standard cable tensiometer, check that tension of autopilot cables is 105 (±10) pounds at 70 degrees F (21 degrees C). Increase or decrease specified cable tension 0.5 pound for each degree F (1.0 pound for each degree C) increase or decrease respectively in free air temperature.

(12) Using rudder pedal adjustment cranks, adjust each set of rudder pedals to maximum forward position. Reference adjacent structure at centerline of each rudder pedal. In neutral position, all rudder pedals shall be parallel within 0.25 inch.

(13) Adjust each set of rudder pedals to maximum aft position. In neutral position, all rudder pedals shall be parallel to within 0.25 inch and adjustment range shall be 8 (±0.50) inches. Measure from centerline of rudder pedal to corresponding reference mark (step 12).

C. Rudder Friction and Rudder Travel Checks.

(1) Make sure that rudder hydraulic system is not pressurized. If airplane hydraulic system, or systems, are pressurized, connect external electric power source to airplane electric circuits. Close SYS 1 and SYS 2 POWER RUDDER CONTROL circuit breakers and move power rudder control switches to OFF position.

(2) Install tools 30-15000-901 RGTL #1 and #2 to measure rudder, flight tab, and trim tab travel (see Figure 203).

(3) Manually deflect rudder 5 (±0.5) degrees right of streamline position.

(4) Attach spring scale to rudder trailing edge just above rudder flight tab and, using spring scale, position rudder 5 (±0.5) degrees left of streamline. Force required to move rudder from 5 (±0.5) degrees right of streamline to 5 (±0.5) degrees left of streamline shall not exceed 15 pounds.

(5) Using spring scale, pull rudder from 5 (±0.5) degrees left to 5 (±0.5) right of neutral. Maximum force required shall not exceed 15 pounds.

(6) Using spring scale, continue to deflect rudder to right until rudder stop is contacted. Force required to contact stop shall not exceed 30 pounds and rudder shall be 25 (+1, -0.25) degrees right of neutral when stop is contacted.

(7) Return rudder to neutral position.

(8) Using spring scale, deflect rudder to left until stop is contacted. Force required to move rudder from 5(±0.5) degrees left to full left travel shall not exceed 30 pounds and rudder shall be 25 (+1, -0.25) degrees left of streamline when stops are contacted.

(9) Remove spring scale from rudder trailing edge.

D. Rudder Cockpit Stops Check.

(1) Clear rudder travel area of all obstructions and remove all rudder, rudder flight tab, and rudder trim tab locking devices.

(2) Pressurize both airplane hydraulic systems (refer to Chapter 29, HYDRAULIC POWER). Move *POWER RUDDER-SYS 1 and SYS 2 (**NO. 1 and NO. 2 POWER RUDDER) switches to the ON position.

(3) Slowly depress pilot's RH rudder pedal until power stops on rudder control quadrant (vertical fin) just make contact.

(4) Gap at rudder stops in cockpit shall be 0.272 (±0.03) inches when power stops just make contact.

(5) Release RH Rudder pedal and repeat steps (3) and (4) with LH rudder pedal.

(6) Relieve hydraulic system pressure (refer to Chapter 12, SERVICING) or move power rudder control switches to OFF position. Make sure that POWER RUDDER CONTROL circuit breakers are closed and that electric circuits are energized.

E. Test Flight Tab Travel.

(1) Make sure that rudder hydraulic system is depressurized (refer to paragraph B or C).

(2) Using tool 30-15000-901 RGTL #1, secure rudder in streamline position (see Figure 203).

CAUTION: DO NOT SECURE RUDDER IF ANY PART OF RUDDER HYDRAULIC SYSTEM IS PRESSURIZED.

(3) Depress pilot's RH rudder pedal until flight tab stops make contact. Rudder flight tab shall move left not less than 26.25 degrees.

(4) Release RH rudder pedal and depress pilot's LH rudder pedal until flight tab stop makes contact. Rudder flight tab shall move right not less than 26.25 degrees.

*Applicable to airplanes CV1 through CV25.
**Applicable to airplanes CV26 and on.

(5) Return rudder pedals and flight tab to neutral position.

(6) Remove portion of tool 30-15000-901 RGTL #1 used to secure rudder in streamline position.

F. Check Rudder Throw In Normal (Power) Mode

(1) Make sure that rudder area is clear of all obstructions that might interfere with rudder travel. Make sure that rudder, rudder flight tab, and rudder trim tab locking devices are removed or released.

(2) Pressurize both airplane hydraulic systems (refer to Chapter 29, HYDRAULIC POWER). Move power rudder control switches to ON position.

(3) Using rudder trim knob on pilot's pedestal, trim rudder to zero degree position.

(4) Slowly depress copilot's RH rudder pedal until power stops, on rudder control quadrant, make contact and prevent further rudder pedal movement. Rudder shall be deflected 25 (±0.5) degrees right of streamline when power stops make contact.

(5) Slowly depress copilot's LH rudder pedal until power stops make contact and prevent further rudder pedal movement. Rudder shall be deflected 25 (±0.5) degrees left of streamline when stops make contact.

(6) Allow rudder pedals to return to neutral. Rudder shall return to within 0.5 degree of streamline position.

G. Test Rudder Power Trim.

(1) Make sure that rudder area is clear of all obstructions that may interfere with rudder travel. Make sure that rudder, rudder flight tab, and rudder trim tab locking devices are removed or released.

(2) Pressurize both airplane hydraulic systems (refer to Chapter 29, HYDRAULIC POWER). Move power rudder control switches to ON position.

(3) Install tool 22-04304TSTO-P on rudder trim knob to adapt a torque wrench to measure forces required to turn trim knob (see 27-2-0, Figure 203).

(4) Adjust rudder trim knob to obtain a zero degree trim indication on trim indicator on pilots' pedestal. Rudder and rudder trim tab shall be within 0.5 degree of streamline position.

(5) Using a torque wrench, rotate rudder trim knob clockwise, then counterclockwise to 3, 6.5, and 23 degree positions. Stop at each position and check positions of rudder and rudder trim tab. Rudder shall move right and trim tab shall move left as trim knob is rotated clockwise. Rudder shall move left and trim tab shall move right as trim knob is rotated counterclockwise. Force required to rotate trim knob shall not exceed 12 inch-pounds at any rudder or rudder trim tab position. Rudder and rudder trim tab shall move to positions indicated in Table I as trim knob is rotated.

TABLE I

TEST NO.	DIAL INDICATOR READING	RUDDER POSITION	TRIM TAB POSITION
1.	0°	0° (±0.5°)	0° (±0.5°)
2.	3° right	0.9° (±0.5°) right	3° (±0.5°) left
3.	12° right	3.4° (±0.5°) right	12° $\binom{+0.75^\circ}{-0.50^\circ}$ left
4.	Rudder Trim Cockpit Stop Contacted (full right travel)	6.5° (±0.5°) right	23° $^{+0.5^\circ}_{-1.0^\circ}$ left
5.	3° left	0.9° (±0.5°) left	3° (±0.5°) right
6.	12° left	3.4° (±0.5°) left	12° $\binom{+0.75^\circ}{-0.50^\circ}$ right
7.	Rudder Trim Cockpit Stop Contacted (full left travel)	6.5° (±0.5°) left	23° $^{+0.5^\circ}_{-1.0^\circ}$ right
8.	0°	0° (±0.5°)	0° (±0.5°)

(6) When rudder trim checks are satisfactory, relieve hydraulic system pressure (refer to Chapter 12, SERVICING) or move power rudder control switches to OFF position. Make sure that POWER RUDDER CONTROL circuit breakers are closed and that electric circuits are energized.

(7) Remove test tool from rudder trim knob.

H. Check Rudder Gust Lock.

(1) With rudder pedals in neutral position, attach spring scale to gust lock handle as near as possible to handle shank.

(2) Pull straight back on spring scale. Handle must be free to rotate in any "pulled-out" position. Force required to pull handle shall not exceed 35 pounds at any point in handle travel.

(3) Pull handle out and hook end of handle over nose wheel steering wheel.

(4) Check position of gust lock shaft cranks and links connecting cranks to locking pawls. Pivot points of links and pivot points of shaft shall be on center (in line) to 0.06 inch before center. Gust lock shaft shall be in contact with stop pads.

(5) Unhook end of handle and allow handle to return to stowed position. Rudder pedals shall be free to move through full travel.

3. Adjustment/Test Rudder Control System Electrical Test

A. Equipment Required.

(1) External hydraulic power source to deliver hydraulic pressures up to 3000 psig.

(2) External electric power source to deliver 115/208 volts at 400 cycles per second.

B. Test Power Rudder Control and Warning System.

(1) Connect external hydraulic power source and pressurize both airplane hydraulic systems (refer to Chapter 29, HYDRAULIC POWER).

(2) Connect external electric power source to airplane and energize 28 volt DC essential bus and 28 volt DC emergency bus (refer to Chapter 24, ELECTRICAL POWER).

(3) Actuate *POWER RUDDER-SYS 1 and SYS 2 (**NO. 1 and NO. 2 PWR RUDDER) switches to OFF positions.

(4) Open SYS 2-RUDDER POWER OFF, circuit breaker.

(5) Close circuit breakers as follows:

(a) SYS 1-POWER RUDDER CONTROL

(b) SYS 2-POWER RUDDER CONTROL

(c) SYS 1-RUDDER POWER OFF. SYSTEM NO. 1-SYSTEM OFF light shall illuminate.

*Applicable to airplanes CV1 through CV25.
**Applicable to airplanes CV26 and on.

(d) SYS 2-RUDDER POWER OFF. SYSTEM NO. 2-SYSTEM OFF light shall illuminate.

(e) MANUAL RUDDER MODE WARN. MANUAL RUDDER MODE warning light shall illuminate.

(f) RUDDER EXCESS POWER.

(g) RUDDER LOW POWER.

(6) Actuate *POWER RUDDER - SYS 1 (**NO. 1 PWR RUDDER) switch to ON position. MANUAL RUDDER MODE warning light and SYSTEM NO. 1-SYSTEM OFF light shall extinguish.

(7) Actuate *POWER RUDDER - SYS 2 (**NO. 2 PWR RUDDER) switch to ON position. MANUAL RUDDER MODE and SYSTEM NO. 1-SYSTEM OFF light shall remain extinguished. SYSTEM NO. 2-SYSTEM OFF light shall extinguish.

(8) *Depress and hold SYSTEM NO. 1-EXC PWR TEST switch on copilot's instrument panel (**hold EXCESS PWR TEST switch on flight engineer's instrument panel in SYS 1 position).

(9) EXCESS POWER and SYSTEM NO. 2-SYSTEM OFF lights shall illuminate. MANUAL RUDDER MODE warning light and SYSTEM NO. 1-SYSTEM OFF light shall remain extinguished.

(10) Release test switches. EXCESS POWER and SYSTEM NO. 2-SYSTEM OFF lights shall extinguish.

(11) *Depress and hold SYSTEM NO. 2-EXC PWR TEST switch on copilot's instrument panel (**hold EXCESS PWR TEST switch on flight engineer's instrument panel in SYS 2 position).

(12) EXCESS POWER and SYSTEM NO. 1-SYSTEM OFF lights shall illuminate.

(13) Release test switches. EXCESS POWER light and SYSTEM NO. 1-SYSTEM OFF light shall extinguish.

(14) Actuate *POWER RUDDER - SYS 1 (**NO. 1 PWR RUDDER) switch to OFF position. SYSTEM NO. 1-SYSTEM OFF light shall illuminate.

(15) Open SYS 1-RUDDER POWER OFF circuit breaker. SYSTEM NO. 1-SYSTEM OFF light shall extinguish and LOW POWER light shall illuminate.

(16) Close SYS 1-RUDDER POWER OFF circuit breaker. LOW POWER light shall extinguish and SYSTEM NO. 1-SYSTEM OFF light shall illuminate.

*Applicable to airplanes CV1 through CV25.
**Applicable to airplanes CV26 and on.

(17) Actuate *POWER RUDDER - SYS 1 (**NO. 1 PWR RUDDER) switch to ON position. SYSTEM NO. 1-SYSTEM OFF light shall extinguish.

(18) Actuate *POWER RUDDER - SYS 2 (**NO. 2 PWR RUDDER) switch to OFF position. SYSTEM NO. 2-SYSTEM OFF light shall illuminate.

(19) Open SYS 2-RUDDER POWER OFF circuit breaker. LOW POWER light shall illuminate and SYSTEM NO. 2-SYSTEM OFF light shall extinguish.

(20) Close SYS 2-RUDDER POWER OFF circuit breaker. LOW POWER light shall extinguish and SYSTEM NO. 2-SYSTEM OFF light shall illuminate.

(21) Acutate *POWER RUDDER - SYS 2 (**NO. 2 PWR RUDDER) switch to ON position. SYSTEM NO. 2-SYSTEM OFF light shall extinguish.

(22) Cycle rudder pedals to full left and full right travel. Rudder shall move smoothly left and right as rudder pedals are cycled.

CAUTION: BEFORE CYCLING RUDDER PEDALS, MAKE SURE THAT RUDDER AREA IS CLEAR OF OBSTRUCTIONS THAT COULD INTERFERE WITH RUDDER TRAVEL.

(23) Actuate *POWER RUDDER - SYS 1 (**NO. 1 PWR RUDDER) switch to OF position.

NOTE: No further monitoring of the warning light system is necessary.

(24) Cycle rudder pedals to full right and full left travel. Rudder shall move smoothly right and left as rudder pedals are cycled.

(25) Actuate *POWER RUDDER - SYS 1 (**NO. 1 PWR RUDDER) switch to ON position and *POWER RUDDER - SYS 2 (**NO. 2 PWR RUDDER) switch to OFF position.

(26) Cycle rudder pedals to full left and full right travel. Rudder shall move smoothly left and right as rudder pedals are cycled.

(27) Actuate *POWER RUDDER - SYS 1 (**NO. 1 PWR RUDDER) switch to OF position.

(28) Cycle rudder pedals to full left and full right travel. Rudder controls shall be in manual mode and rudder pedal travel will result in rudder flight tab deflection. There shall be little, if any, rudder deflection.

(29) Actuate No. 1 and No. 2 power rudder switches to the ON position; then, using a soft lead pencil, place a reference mark on the airplane fuselage at the trailing edge of the rudder trim tab.

*Applicable to airplanes CV1 through CV25.
**Applicable to airplanes CV26 and on.

(30) Actuate *POWER RUDDER-SYS 1 (**NO. 1 PWR RUDDER) switch to OFF position and measure distance trim tab trailing edge has moved from position marked in step (29). Record this measurement.

(31) Actuate *POWER RUDDER-SYS 1 (**NO. 1 PWR RUDDER) switch to ON position and mark position of rudder trim tab trailing edge if position is different from mark placed on fuselage in step (29).

(32) Actuate *POWER RUDDER - SYS 2 (**NO. 2 PWR RUDDER) switch to OFF position and measure distance trim tab trailing edge has moved from position marked in step (31). Record this measurement.

(33) The difference between measurements recorded in steps (30) and (32) shall not exceed 0.10 inch.

(34) Close GUST LOCK circuit breaker on Flight Engineers circuit breaker panel.

(35) Gust lock lockout solenoid shall actuate and it shall not be possible to engage rudder gust lock.

(36) Depressurize No. 1 hydraulic system (refer to Chapter 12, Servicing).

(37) Lockout solenoid shall deactuate and with rudder pedals in neutral position gust lock shall engage when handle is pulled out.

(38) Disconnect and remove test equipment and restore airplane to normal configuration.

4. Adjustment/Test Rudder System Force Checks

A. Equipment Required.

(1) Tool 30-15000-901 RGTL #1 for securing rudder in neutral position and checking rudder travel (see Figure 203).

(2) Tool 30-15000-901 RGTL #2 for securing flight tab in neutral position and checking rudder flight tab travel (see Figure 203).

(3) Tool TSTO 22-46246-1 pitot adapter and mercury manometer for testing "Q" cylinder.

(4) Force measuring devices, suitable for measuring compression and tension loads, with ranges from 0 to 50 pounds and 0 to 100 pounds.

(5) External source of hydraulic power.

(6) External source of ac electrical power.

*Applicable to airplanes CV1 through CV25.
**Applicable to airplanes CV26 and on.

(7) Source of dry filtered air, controllable from zero to two inches of mercury.

B. Rudder System Force Check (Hydraulic Pressure Off).

(1) Determine whether or not rudder hydraulic system is pressurized. If airplane hydraulic system is pressurized, make sure that airplane electrical system is energized and that power rudder control switches are in OFF position. Close POWER RUDDER CONTROL circuit breakers on main circuit breaker panel.

(2) Install tool 30-15000-901 RGTL #1 and secure rudder in streamline position.

(3) Install tool 30-15000-901 RGTL #2 between rudder flight tab and trim tab to measure flight tab travel.

(4) Install force measuring device (0-50 pounds) at rudder pedals.

NOTE: Attach force measuring device to rudder pedal at brake pedal pivot line. Exert all forces parallel to flight compartment floor.

(5) Slowly apply compression load to pilot's right rudder pedal until flight tab stop is contacted and record forces at 5 and 25 degrees flight tab travel. Readings must be taken while flight tab is in transit. Forces must be less than 12 and 16 pounds at 5 and 25 degrees respectively. Total flight tab travel shall be 26.25 degrees minimum.

(6) Slowly return right rudder pedal to neutral position. While flight tab is in transit, read and record forces at 25 and 5 degrees flight tab travel. Forces must not be less than -5 pounds at 25 and 5 degrees respectively.

NOTE: Negative values indicate tension load or pedal forces directed toward pedal neutral position.

(7) Difference between forces in Steps (5) and (6) shall not exceed 14.5 and 17 pounds at 5 and 25 degrees respectively.

(8) Repeat Steps (5), (6), and (7) using pilot's left rudder pedal.

(9) Release rudder from streamline position; move rudder to 14 degrees right position and secure.

(10) Slowly apply compression to pilot's right rudder pedal until flight tab stop is contacted. While flight tab is in transit, read and record forces at 15 and 25 degrees flight tab travel. Forces must not exceed 22 and 35 pounds at 15 and 25 degrees respectively.

(11) Slowly return right rudder pedal to neutral position. While flight tab is in transit, read and record forces at 25 and 15 degrees flight tab travel. Forces must not be less than 5 and -2 pounds at 25 and 15 degrees respectively.

(12) Difference between forces recorded in Steps (10) and (11) shall not exceed 23 and 21 pounds at 25 and 15 degrees respectively.

(13) Release rudder from 14 degrees right position; move to 14 degrees left position and secure.

(14) Repeat Steps (10), (11), and (12) using pilot's left rudder pedal.

(15) Remove force measuring device from rudder pedals.

C. Rudder System Force Check (Hydraulic Pressure On).

(1) Install TSTO 22-46246 (pitot adapter) and mercury manometer on "Q" cylinder intake on leading edge of vertical stabilizer.

(2) Connect source of dry filtered air, controllable from zero to two inches of mercury, to pitot adapter.

(3) Install force measuring device (0-100 pounds) at rudder pedals.

(4) Connect external source of ac electrical power to airplane (refer to Chapter 24, ELECTRICAL POWER).

(5) Connect external source of hydraulic power to airplane and pressurize airplane's No. 1 and No. 2 hydraulic systems (refer to Chapter 29, HYDRAULIC POWER).

(6) Actuate power rudder control switches to ON position.

CAUTION: BEFORE CYCLING RUDDER PEDALS, MAKE SURE THAT RUDDER AREA IS CLEAR OF OBSTRUCTIONS THAT COULD INTERFERE WITH RUDDER TRAVEL.

(7) Slowly apply a compression load to pilot's right rudder pedal until rudder stop is contacted. While rudder is in transit, read and record forces at 5, 15 and 25 degrees of rudder travel. Forces must not exceed 16, 21 and 42 pounds at 5, 15 and 25 degrees of rudder travel respectively.

(8) Slowly return right rudder pedal to neutral position. While rudder is in transit, read and record forces at 25, 15 and 5 degrees. Forces shall not be less than 13, 0 and -1 pounds at 25, 15 and 5 degrees respectively.

(9) Difference between forces recorded in Steps (7) and (8) shall not exceed 14, 16 and 20 pounds at 5, 15 and 25 degrees respectively.

(10) Repeat Steps (7), (8) and (9) using pilot's left rudder pedal.

(11) Slowly apply air pressure at "Q" cylinder intake to 1.17 inches of mercury as read on mercury manometer.

(12) Repeat Steps (7) and (8) using pilot's right and left rudder pedals. When repeating Step (7), forces shall not exceed 34, 69 and 87 pounds at 5, 15 and 25 degrees respectively.

(13) When repeating Step (8), forces recorded at 25, 15 and 5 degrees shall not be less than 37, 27 and 9 pounds respectively.

(14) Difference between forces recorded in Steps (12) and (13) shall not exceed 17, 24 and 28 pounds at 5, 15 and 25 degrees respectively.

(15) Remove test tools and return airplane to normal configuration.

5. Adjustment/Test Rudder Control System Bleeding Procedure

A. General.

The hydraulic system, or systems, must be bled to remove trapped air whenever any system line or component has been disconnected.

B. Equipment Required.

(1) External hydraulic power source capable of delivering eight gallons of hydraulic fluid per minute at 3000 psig.

C. Bleed Rudder Control Hydraulic System.

(1) Connect external hydraulic power source and pressurize both airplane hydraulic systems (refer to Chapter 29, HYDRAULIC POWER).

NOTE: Rudder system shutoff valves and bypass shutoff valves are normally open (energized to close). No electric power is required. If airplane electrical system is energized, open all rudder control system circuit breakers (refer to Adjustment/Test Rudder Control System Electrical Test).

(2) Examine area of rudder travel and remove any obstructions to rudder travel.

(3) Cycle rudder slowly from full left to full right ten times.

(4) Depressurize hydraulic systems (refer to Chapter 12, SERVICING).

(5) Return airplane to normal configuration.

RUDDER - MAINTENANCE PRACTICES

1. Removal/Installation Rudder (see Figure 201)

A. General.

Prior to installing a rudder, it must be ascertained that the rudder is balanced. Date of balancing and the number of pounds nose heavy are stamped on rudder nameplate. Any rudder flight tab can be used without rebalancing the rudder provided the flight tab is balanced and its total weight does not exceed 29.76 pounds. The rudder trim tab is not balanced, and any trim tab may be used provided the tab's total weight does not exceed 10.88 pounds. (Do not include attaching parts (nuts, bolts, and washers) when weighing tabs.) If the flight or trim tab is not within weight tolerance, the rudder must be rebalanced (refer to the 990 Structural Repair Manual).

B. Equipment Required.

(1) Sling 4PE-22494.

(2) Hoist capable of lifting rudder.

(3) Graphite grease, Specification MIL-G-7187.

(4) Torque wrench calibrated in inch-pounds.

(5) Work stand suitable for reaching all rudder hinge locations.

(6) Tool 30-15000-901 RGTL #1 for streamlining rudder surface with vertical stabilizer, and maintaining rudder in fully deflected position (see 27-7-0, Figure 203).

(7) Tool 30-15000-901 RGTL #2 for streamlining rudder flight tab with rudder (see 27-7-0, Figure 203).

(8) Index pin 22-J107-3.0.

(9) External source of hydraulic power.

(10) Standard cable tensiometer.

C. Remove Rudder.

(1) Open rudder hinge support access doors and shroud doors on each side of vertical stabilizer.

(2) Remove balance weight access panels from above top hinge support access doors.

(3) Remove hinge fairing access plates from right side of rudder.

(4) Disconnect manual trim drum cables in aircraft tail cone and pull cables up through rudder nose. Carefully note cable routing so cables can be properly installed. Coil and tie cables at trim jack.

(5) Disconnect forward ends of rudder trim tab control rods from trim jack.

(6) Disconnect aft ends of rudder flight tab control rods from bell crank in rudder control package.

(7) Disconnect aft ends of four rudder actuators.

(8) Remove all retainers attaching curtain seals to stabilizer. Mark retainers for installation. Bundle and tie curtains against rudder to prevent damage during removal of rudder.

(9) Disconnect spring-cartridge control rod at rudder servo control valve bell crank and remove pivot bolt attaching bell crank to rudder.

(10) Disconnect bonding jumpers at each hinge point.

(11) Attach rudder sling to rudder hoist points (see Figure 202).

(12) Remove hinge bolt from No. 1 hinge.

(13) Remove hinge bolts and cone bushings from all remaining hinges.

(14) Slide rudder aft until assembly clears vertical stabilizer and remove from airplane. Rotate rudder to one side before removing to prevent interference with airplane fuselage.

CAUTION: USE CARE IN HANDLING RUDDER TO AVOID BREAKING CADMIUM PLATING ON DEPLETED RADIOACTIVE WEIGHT MATERIAL. IF PLATING IS BROKEN OR DAMAGED IN ANY WAY, BALANCE WEIGHT MUST BE RETURNED TO MANUFACTURER AND REPLACED.

D. Install Rudder.

(1) Make sure that curtain seals are installed on leading edge of rudder and attach slinge to rudder.

(2) Connect slinge load bar to hoist and raise rudder into position; align rudder hinge fittings. Use care to avoid damage to curtains.

NOTE: To prevent rudder interference with fuselage, turn rudder to one side while aligning hinges.

(3) Install cone bushings and hinge bolts at hinges No. 2 through No. 6 (refer to 27-0, Installation Split Cone Bushings).

NOTE: Torque nuts on hinge bolts to between 160 and 190 inch-pounds.

(4) Deleted.

(5) Manually deflect rudder to limits of right- and left-hand travel. Rudder must travel 25 (+1, -0.25) degrees in each direction.

(6) Bleed rudder hydraulic system (refer to Adjusment/Test Rudder Control System Bleeding Procedure).

(7) Test system (refer to 27-7-0, Adjustment/Test Rudder Control System Functional Test).

(8) Clean up any spilled hydraulic fluid and close access door.

NOTE: If a rudder hydraulic actuator only has been replaced and no other rigging or adjustment has been changed, check rudder control system operation per 27-7-0, paragraph 4.C.

RUDDER PEDAL ASSEMBLY - MAINTENANCE PRACTICES

1. Removal/Installation Rudder Pedal Assembly (see Figure 201

A. General.

Removal and installation procedures are the same for the pilot's and copilot's rudder pedal assemblies. The procedures for removing and installing only the pilot's rudder pedal assembly is included.

B. Equipment Required.

(1) Stand suitable for reaching nose section access door.

(2) Index pins 22-J107-2.0(2), 22-J107-3.0(2), and 22-J107-5.0(1).

(3) Test tool TSTO 22-04309 or equivalent protractor, to rig brake pedal neutral position and check pedal travel.

C. Remove Rudder Pedal Assembly.

(1) Disconnect lower joint of rudder pedal adjustment torque shaft by drilling out connecting rivet.

(2) Remove 20 mounting screws from rudder pedal housing and lift housing away from rudder pedals.

(3) Remove rudder pedal adjustment control by removing four mounting bolts.

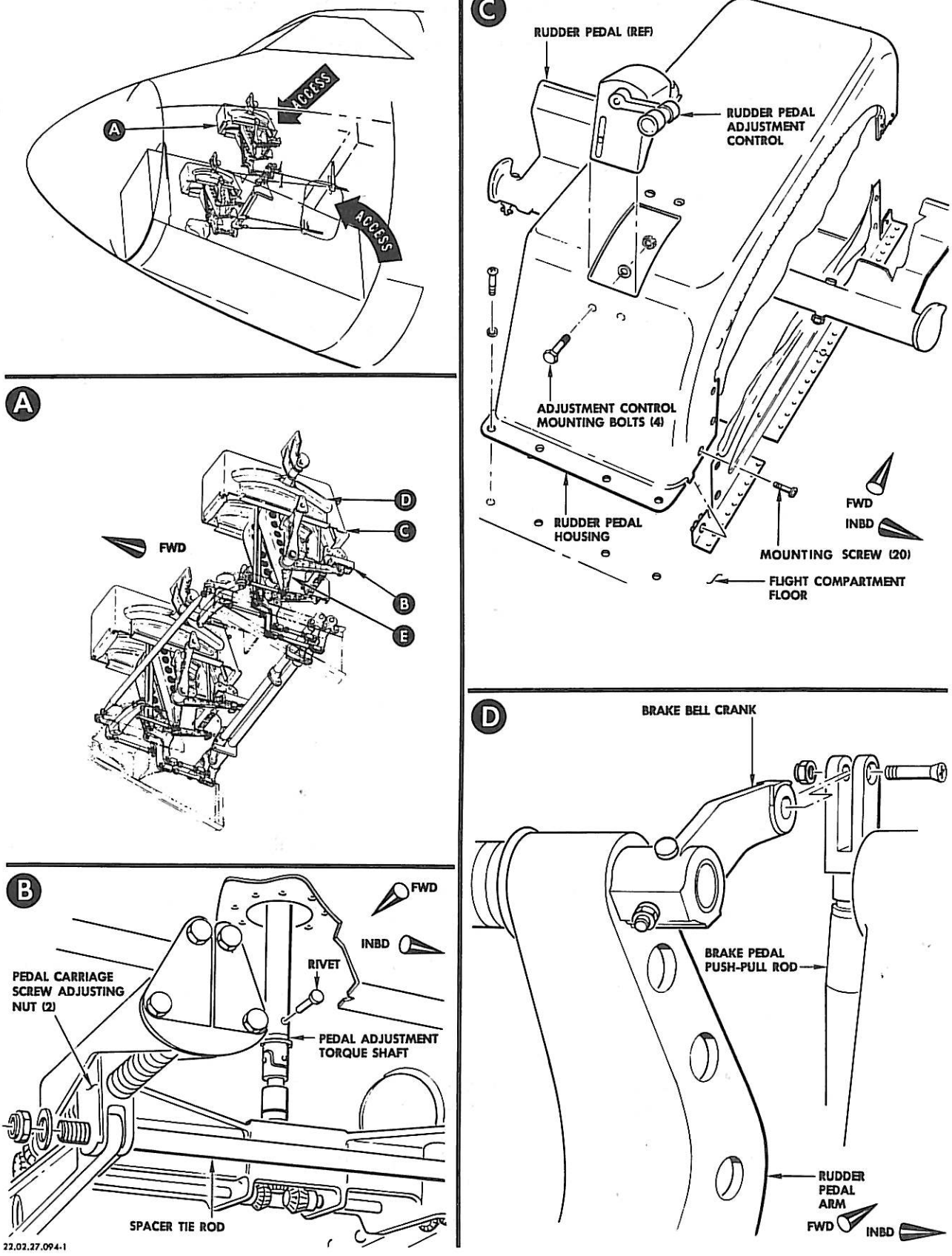
(4) Disconnect upper end of brake push-pull rods from brake bell cranks.

(5) Remove cotter pin and lock nut from one end of spacer tie rod connecting rudder pedal adjusting links and pedal carriage screw adjusting nuts. Slide spacer tie rod out of adjusting link bushings and pedal carriage screw adjusting nuts.

(6) Disconnect control rods connecting lower end of rudder pedal arms and rudder control forward bell crank. (Do not disturb control rod adjustments.)

(7) Remove two bolts from each rudder pedal hanger and bolts from each top outer bushing. Slide hanger tubes out of support bushings toward centerline of rudder pedal assembly.

(8) Rotate rudder pedal assembly 90 degrees and lower through opening in flight compartment floor.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PEDAL CARRIAGE SCREW ADJUSTING NUT (2)
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ADJUSTMENT CONTROL MOUNTING BOLTS (4)
RUDDER PEDAL HOUSING
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BRAKE PEDAL PUSH-PULL ROD
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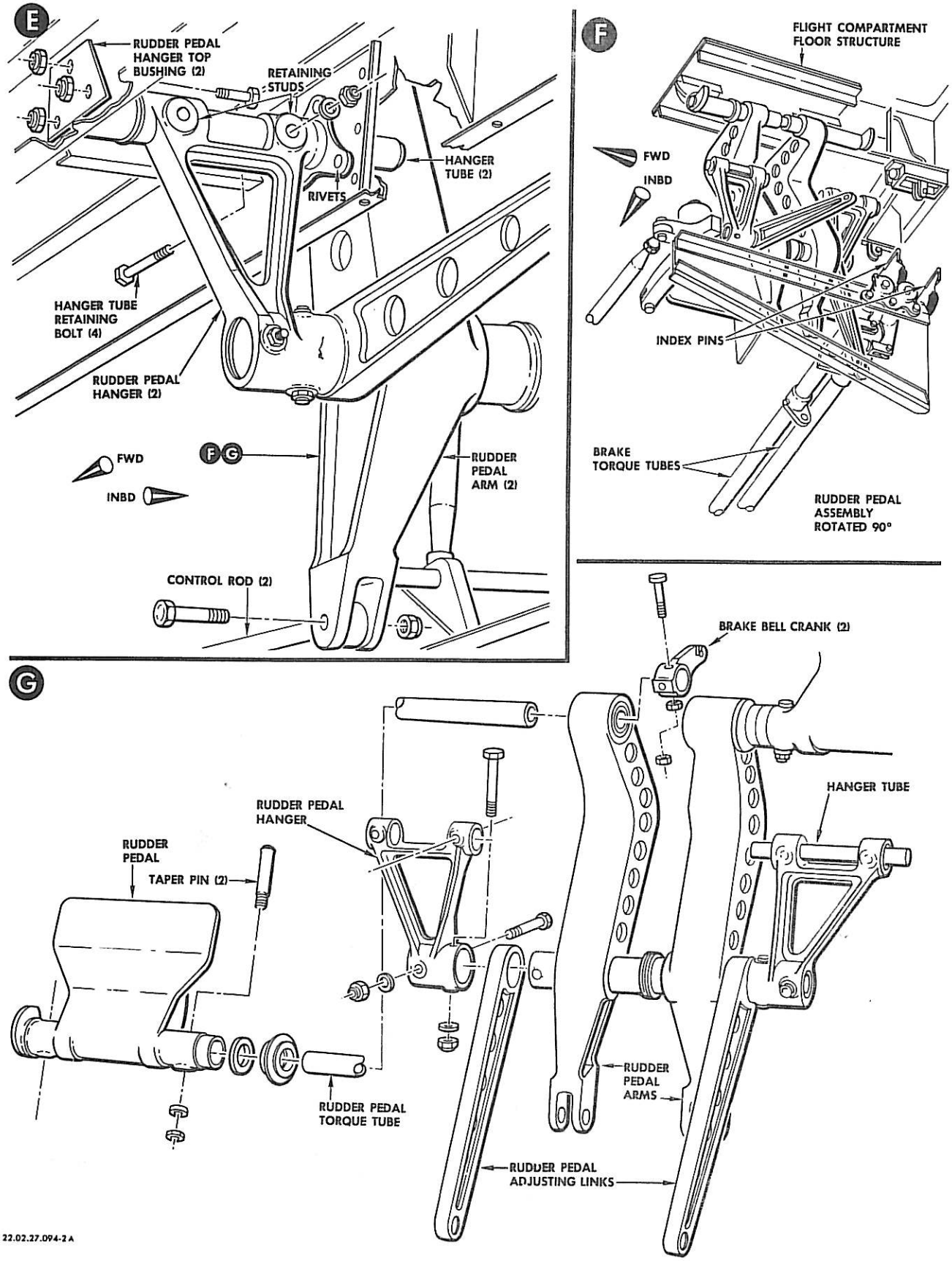
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RUDDER PEDAL HANGER TOP BUSHING (2)
RETAINING STUDS
HANGER TUBE (2)
RIVETS
HANGER TUBE RETAINING BOLT (4)
RUDDER PEDAL HANGER (2)
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F G
RUDDER PEDAL ARM (2)
CONTROL ROD (2)
F
FLIGHT COMPARTMENT FLOOR STRUCTURE
FWD
INBD
INDEX PINS
BRAKE TORQUE TUBES
RUDDER PEDAL ASSEMBLY ROTATED 90°
G
BRAKE BELL CRANK (2)
HANGER TUBE
RUDDER PEDAL HANGER
RUDDER PEDAL
TAPER PIN (2)
RUDDER PEDAL TORQUE TUBE
RUDDER PEDAL ARMS
RUDDER PEDAL ADJUSTING LINKS
22.02.27.094-2 A

(9) Disconnect pedal assembly hangers from pedal assembly pivot tube by removing four taper pins (two from each hanger). Slide hangers, rudder pedal adjusting links, and rudder pedal arms from pedal assembly pivot tube.

(10) Remove two taper pins from brake bell crank and slide bell crank from pedal torque tube. Slide pedal torque tube out of rudder pedal arm bearing.

(11) Remove two taper pins from rudder pedal bushing and slide rudder pedal from pedal torque tube.

D. Install Rudder Pedal Assembly.

(1) Position rudder pedal on pedal torque tube. Insert and secure taper pins in pedal.

(2) Insert pedal torque tube in rudder pedal arm top bearing and position brake bell crank on pedal torque tube. Insert and secure taper pins in bell crank.

(3) Position rudder pedal arms, rudder pedal adjusting links, and pedal assembly hangers on pedal assembly pivot tube. Insert and secure two taper pins in each hanger.

(4) Position rudder pedal assembly, insert hanger tubes through center support bearings and upper hanger bushings, and install hanger outer top bushings. Insert and secure two bolts in each hanger.

(5) Insert index pins 22-J107-3.0 in rudder pedal arms and index pin 22-J107-5.0 in rudder control forward bell crank. Adjust length of two control rods to distance between rigged bell crank and positioned rudder pedal arms. Tighten lock nuts on control rods and install aft ends of control rods on lower end of rudder pedal arms. Remove index pins.

(6) Position and secure spacer tie rod connecting rudder pedal adjusting links and pedal carriage screw adjusting nuts. Center of hole in pedal carriage screw adjusting nuts shall be 1.77 inches ahead of aft face of pedal adjusting carriage casting.

(7) Set brake pedals in neutral position with brakes released and parking brake handle in fully retracted (off) position.

(8) Insert index pins 22-J107-2 (2) through left and right brake quadrants (station 972) and adjacent structure.

(9) With face of each rudder pedal at 90-degree angle with flight compartment floor, as determined with TSTO 22-04309, connect brake control rod to brake bell crank. Adjust control rod if necessary. Safety-wire control rod and remove index pins installed in step (8).

(10) Check brake pedal adjustment (refer to Chapter 32, LANDING GEAR).

(11) Position rudder pedal adjustment control assembly and install four bolts.

(12) Position rudder pedal housing and install 20 mounting screws.

(13) Center rudder pedal position indicator by rotating adjusting crank. Crank should be straight down when indicator is centered. Connect lower joint of pedal adjusting torque tube and replace connecting rivet. Use 1/8 x 1/2-inch CX/4 rivet.

(14) Adjust rudder pedal assembly (refer to 27-7-0, paragraph 1.H.).

(15) Check operation of rudder pedals (refer to 27-7-0, Adjustment/Test Rudder Control System Functional Test).

NOTE: If a rudder pedal only has been replaced and no other rigging or adjustment changed, check operation of rudder pedals per 27-7-0, steps 2.B.(12), 2.B.(13) and paragraph 4.B.

RUDDER PEDAL GUST LOCK - MAINTENANCE PRACTICES

1. Removal/Installation Rudder Pedal Gust Lock (see Figure 201)

   A. Equipment Required.

      (1) Stand suitable for reaching nose section access door.

   B. Remove Gust Lock Pawl.

      (1) Open nose section access door.

      (2) Remove bolt connecting gust lock shaft link to pawl.

      (3) Remove pawl pivot bolt and remove pawl.

   C. Install Gust Lock Pawl.

      (1) Position pawl in airplane and install pawl pivot bolt.

      (2) Connect gust lock shaft link to aft corner of pawl. Tighten nut on connecting bolt finger-tight only; install cotter pin. Adjust link as outlined in paragraph E.

      (3) Close access door.

   D. Remove Gust Lock Shaft.

      (1) Open nose section access door.

      (2) Disconnect springs from forward sides of gust lock shaft bell cranks.

      (3) Disconnect lower ends of links between gust lock shaft bell cranks and gust lock pawls.

      (4) Remove cotter pins from forward corners of gust lock cable quadrant and remove cable from cable groove.

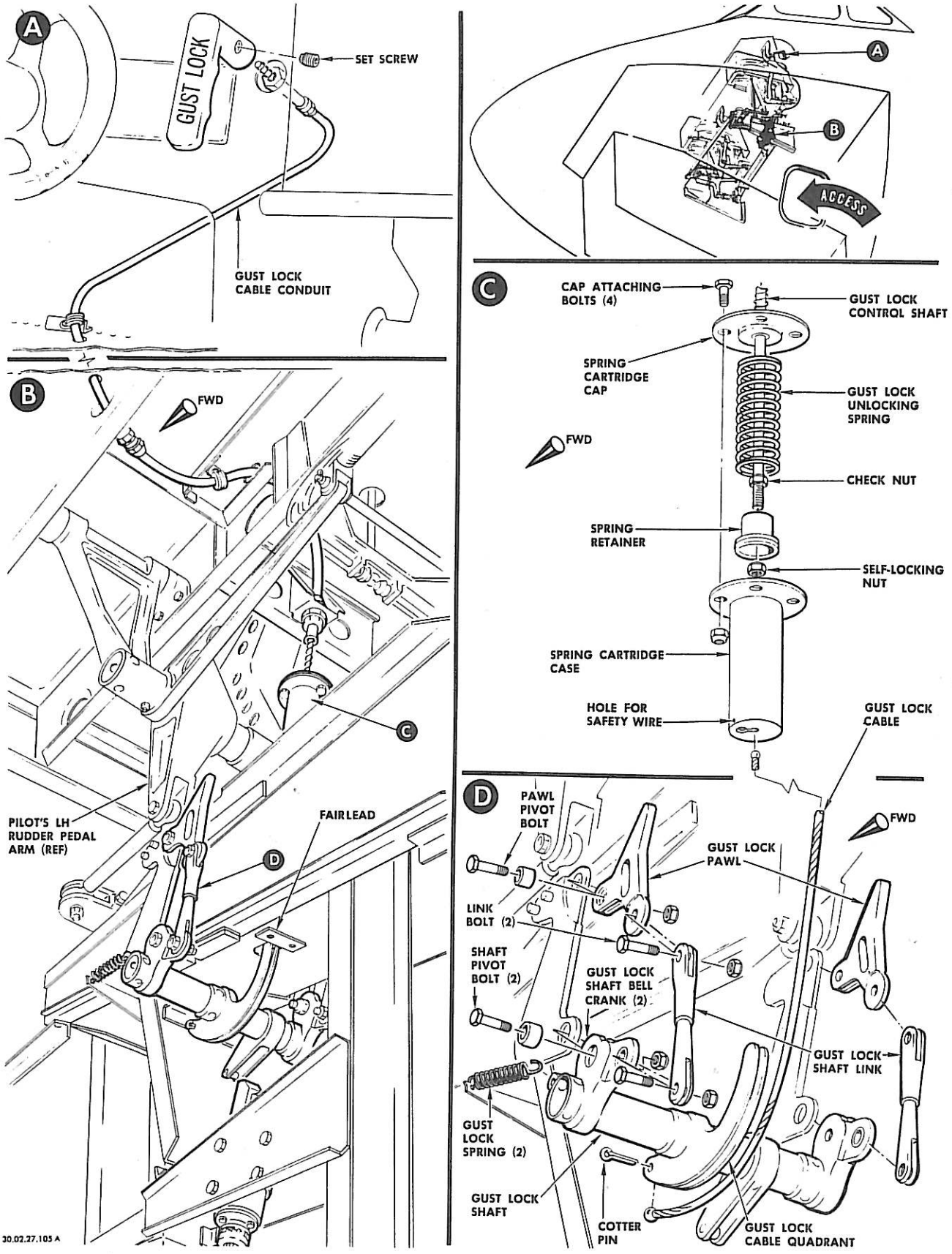
      (5) Remove two shaft pivot bolts and remove gust lock shaft.

   E. Install Gust Lock Shaft.

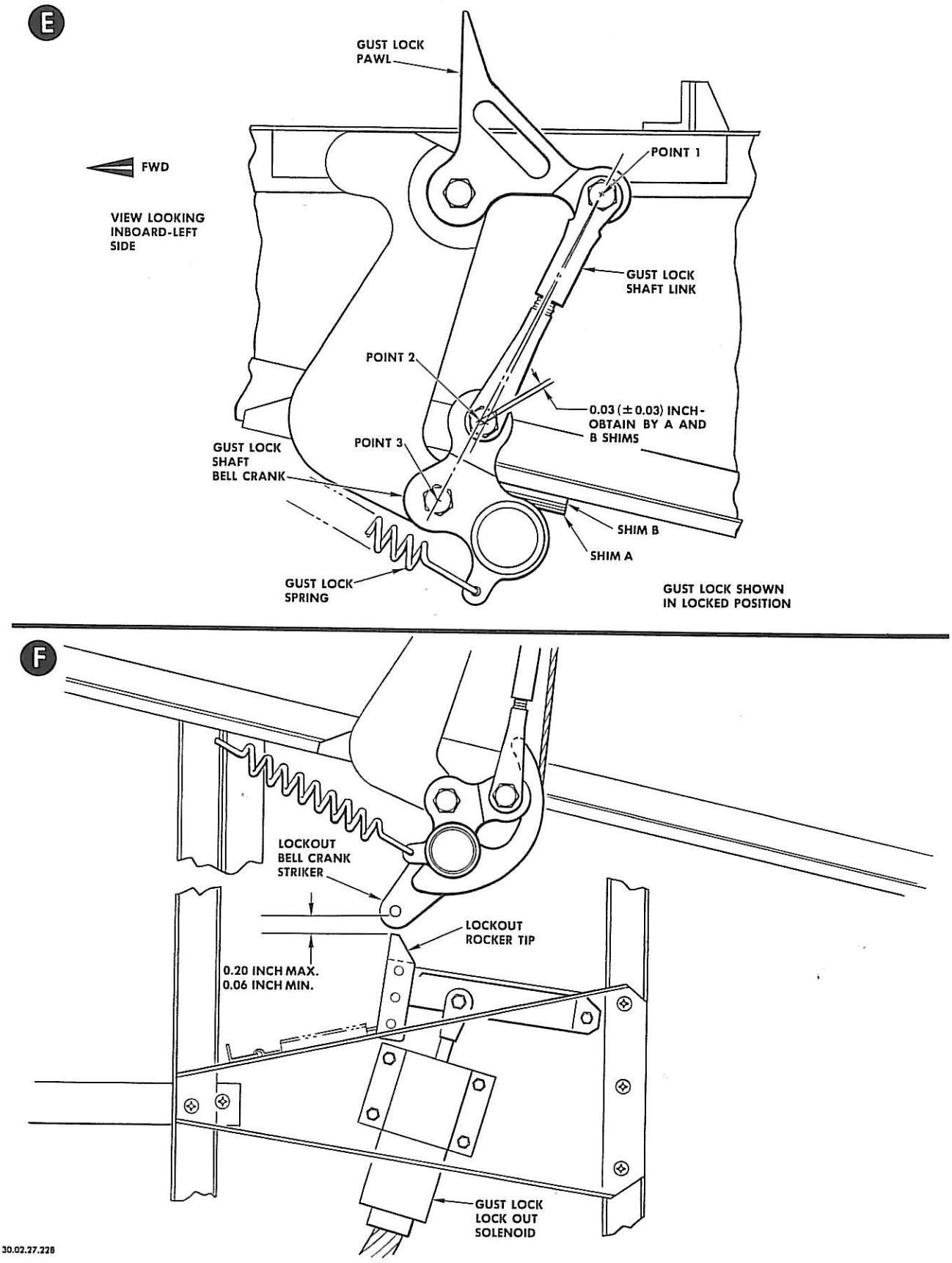
      (1) Position gust lock shaft in airplane and install shaft pivot bolts.

      (2) Position gust lock cable in shaft quadrant cable groove; install cotter pin.

      (3) Check that gust lock lockout solenoid is in deenergized position.



Rudder Pedal Gust Lock Installation
Figure 201 (Sheet 1 of 2)


E
GUST LOCK PAWL
FWD
VIEW LOOKING INBOARD-LEFT SIDE
POINT 1
GUST LOCK SHAFT LINK
POINT 2
0.03 (± 0.03) INCH-OBTAIN BY A AND B SHIMS
POINT 3
GUST LOCK SHAFT BELL CRANK
SHIM B
SHIM A
GUST LOCK SPRING
GUST LOCK SHOWN IN LOCKED POSITION
F
LOCKOUT BELL CRANK STRIKER
LOCKOUT ROCKER TIP
0.20 INCH MAX.
0.06 INCH MIN.
GUST LOCK LOCK OUT SOLENOID
30.02.27.228

(4) Position rudder pedals in neutral position. Pedals must be maintained in this position.

(5) Pull gust lock handle and hook it over nose gear steering wheel.

(6) Rotate gust lock pawls upward until they contact the rudder pedal bell cranks; hold pawls in this position.

(7) Using a six-inch scale, check alignment of points one through three as shown on Sheet 2 of Figure 201.

(8) Obtain specified alignment by use of shims A and B. Shim A is made of 0.190 inch thickness laminated aluminum stock. Shim B is made of 0.090 inch nonlaminated aluminum stock.

NOTE: Shims A and B are attached to the gust lock shaft support structure by rivets. Remove rivets if shim adjustment is required. Reinstall rivets after adjustment, with shim B positioned adjacent to shaft.

(9) With all linkages held to the specified positions and clearances, adjust and install the gust lock shaft links.

(10) Check for 0.03 ($\pm$0.03) inch dimension as shown on Figure 201. It may be necessary to make minor adjustments to the links and to add or remove shims to obtain specified dimension.

(11) After completion of step (10), check that pawls are tight against rudder pedal bell cranks, bell crank shaft is snug against shims, and that 0.03 ($\pm$0.03) dimension is met when gust lock is applied.

(12) Position gust lock to unlocked position.

(13) Check that gust lock lockout solenoid is in deenergized position.

(14) Check clearance between lockout rocker tip and lockout bell crank striker by slowly actuating gust lock to the locked position. Maximum clearance at nearest point of contact shall not exceed 0.20 inch; minimum clearance shall not be less than 0.06 inch. Adjust solenoid rod end to obtain specified clearance.

(15) Test gust lock system. Refer to 27-7-0, paragraph 2.H.

F. Remove Rudder Pedal Gust Lock Spring Cartridge.

(1) Open nose compartment access door.

(2) Disconnect gust lock unlocking springs.

(3) Remove four bolts from top of spring cartridge.

CAUTION: SPRING CARTRIDGE IS SPRING-LOADED. WITH GUST LOCK IN UNLOCKED CONDITION, SPRING-LOAD IS APPROXIMATELY 10 POUNDS. HOLD CAP ON CASE WHILE REMOVING BOLTS AND ALLOW SPRING TO DECOMPRESS SLOWLY.

(4) Remove case from cartridge and disconnect cable from bottom of case. Move cable through slot from center hole to larger hole and pull cable end through large hole.

(5) Remove nut from end of gust lock control shaft and remove spring retainer and spring.

(6) Remove check nut from control shaft and remove cartridge cap.

G. Install Rudder Pedal Gust Lock Spring Cartridge.

(1) Insert gust lock control shaft through bushing in gust lock cartridge cap. Thread check nut onto end of shaft. Run nut up to about 3/8 inch from upper end of threaded part of shaft.

(2) Install spring, spring retainer, and self-locking nut on end of control shaft. Tighten nut. Threaded portions of shaft extending above check nut and below locking nut should be approximately equal.

(3) Insert cable through bottom of spring cartridge case, and seat cable end in center of case. Install safety wire to prevent cable from coming out of slot in spring cartridge case. Make certain that cable is properly positioned in cable guide bracket.

(4) Place spring cartridge case over retainer and bottom of spring and compress spring until cartridge cap fits down against top of case. Use a 4-1/2 inch C-clamp to hold cap in place.

(5) Install four bolts in top of spring cartridge.

(6) Connect gust lock unlocking springs.

(7) Check rudder control system operation (refer to 27-7-0, Adjustment/ Test Rudder Control System Functional Test).

NOTE: If the rudder pedal gust lock only has been replaced and no other rigging or adjustment has been changed, check rudder control system operation per 27-7-0, paragraph 2.H.

(8) Close nose compartment access door.

H. Remove Rudder Pedal Gust Lock Control.

(1) Open nose compartment access door.

(2) Remove rudder pedal gust lock spring cartridge (refer to paragraph F).

(3) Disconnect flexible shaft from gust lock handle and remove handle.

(4) Remove flexible shaft by pulling it through conduit into nose compartment.

(5) Remove conduit by removing mounting clamps and disconnecting fittings.

I. Install Rudder Pedal Gust Lock Control.

(1) Install gust lock control conduit. Tighten fittings and install mounting clamps.

(2) Insert flexible shaft into conduit from nose compartment. When cable emerges from upper end of conduit in cockpit, attach gust lock handle.

(3) Install gust lock spring cartridge and check operation (refer to paragraph G).

(4) Close nose compartment access door.

RUDDER CONTROL FORWARD BELL CRANKS - MAINTENANCE PRACTICES

1. Removal/Installation Rudder Control Forward Bell Cranks (see Figure 201)

   A. Equipment Required.

      (1) Stand suitable for access to nose compartment access door.

      (2) Four index pins 22-J107-5.0, or equivalent.

   B. Remove Rudder Control Forward Bell Crank.

      (1) Open nose compartment access door.

      (2) Relieve tension in rudder cable system by loosening turnbuckle in pilot's rudder control cable located in forward cargo compartment at fuselage station 627. (Access to the turnbuckle is through a zippered curtain at the aft end of the cargo compartment.) Remove clevis bolts connecting pilot's rudder cable to pilot's rudder control forward bell crank.

      (3) Disconnect forward ends of control rods connecting lower end of rudder pedal arms and rudder control forward bell cranks.

      (4) Disconnect interconnect rod from pilot's rudder control forward bell crank.

      (5) Remove bolt attaching rudder control forward bell crank to bell crank bracket.

   C. Install Rudder Control Forward Bell Crank.

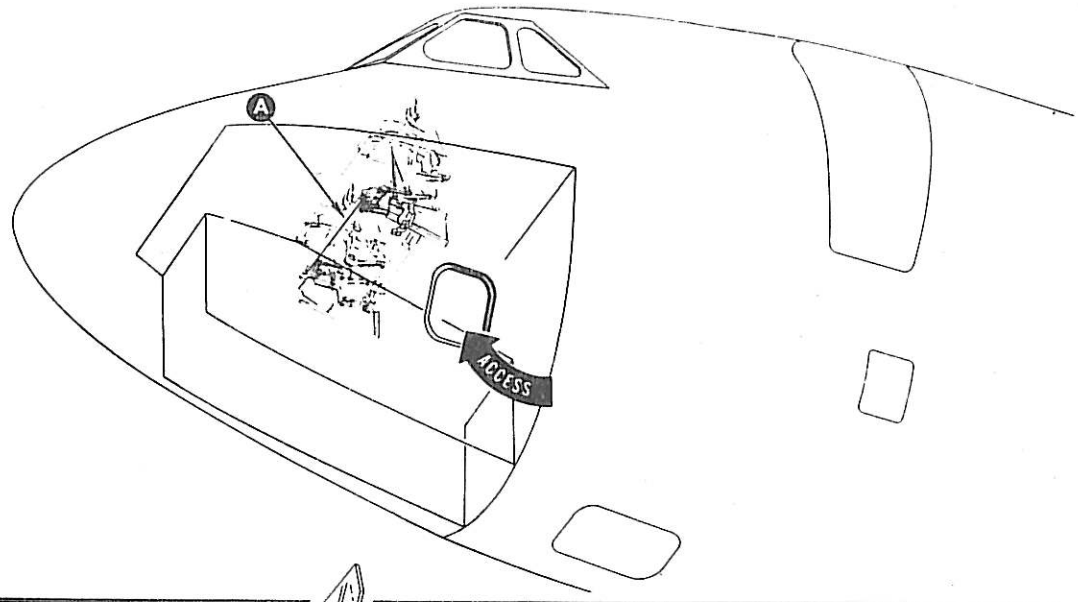
      (1) Position rudder control forward bell crank and install bell crank bolt.

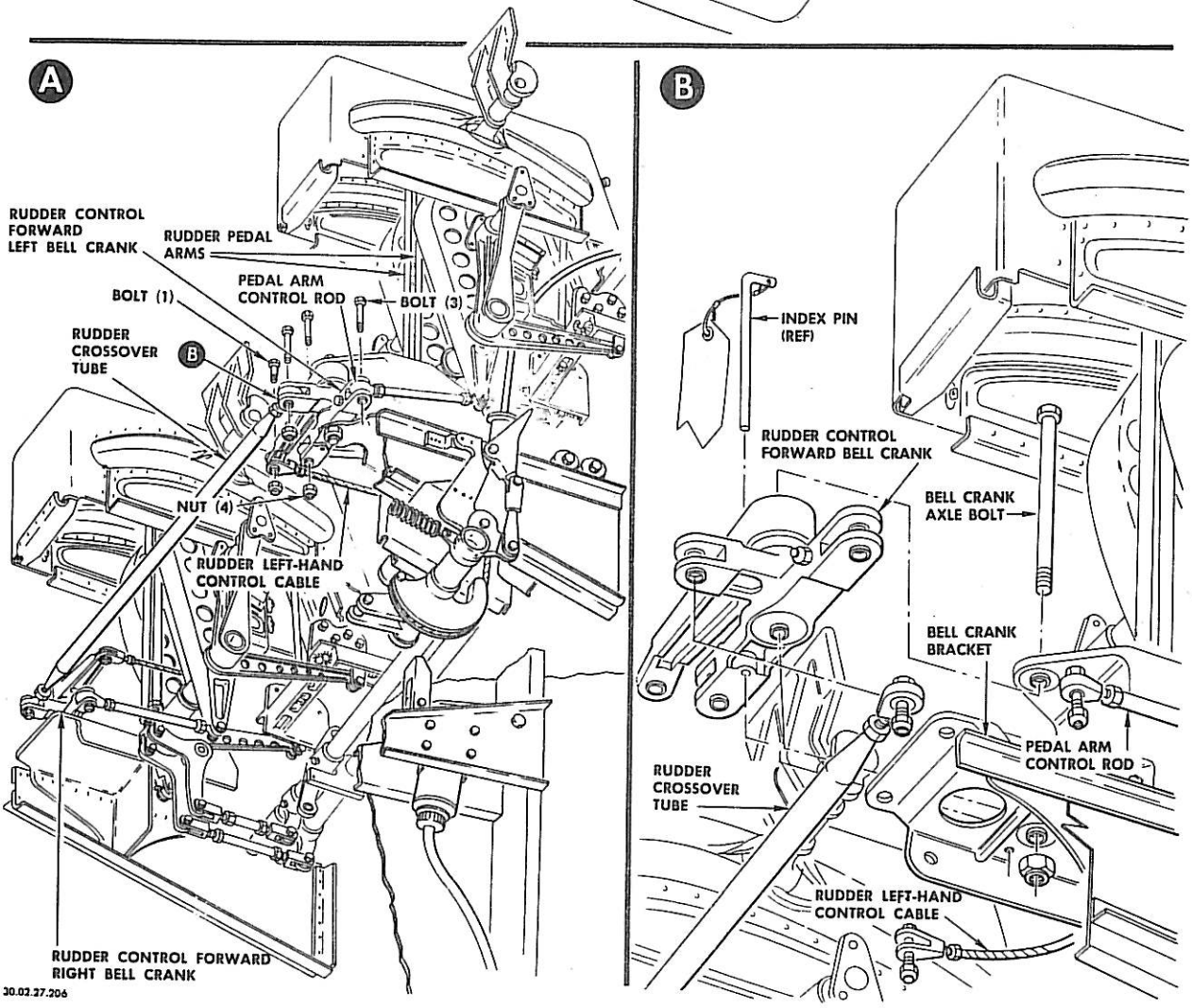
      (2) Install index pins 22-J107-5.0 in pilot's and copilot's forward bell cranks.

      (3) Install free end of interconnect rod on rudder bell crank forward arm. (Adjust length of interconnect rod if necessary.)

      (4) Install forward end of rudder pedal arm control rods on bell crank arms.

      (5) Install clevis bolt connecting pilot's rudder cable to pilot's rudder control forward bell crank. Tighten loosened turnbuckle in pilot's rudder cable until index pin 22-J107-5.0 can be inserted in both pilot's rudder control aft bell cranks. If index pins 22-J107-5.0 cannot be inserted in both rudder control aft bell cranks, rerig rudder control cables (refer to Adjustment/Test Rudder Control System Functional Test). Remove four index pins and safety turnbuckles.





Rudder Control Forward Bell Cranks Installation
Figure 201

(6) Remove all index pins and test system (refer to 27-7-0, Adjustment/ Test Rudder Control System Functional Test).

NOTE: If a rudder control forward bell crank only has been replaced and no other rigging or adjustment has been changed, check rudder control system operation per 27-7-0, paragraphs 2.E. and 4.B.

RUDDER CONTROL AFT BELL CRANKS - MAINTENANCE PRACTICES

1. Removal/Installation Rudder Control Aft Bell Crank (see Figure 201)

A. General.

Two identical rudder control aft bell cranks are located at station 1521. The removal and installation instructions are identical.

B. Equipment Required.

(1) Stand suitable for reaching tail cone access door.

(2) Four index pins 22-J107-5.0.

C. Remove Rudder Control Aft Bell Crank.

(1) Relieve tension in the rudder cable system by loosening rudder control cable turnbuckle located in forward cargo compartment at fuselage station 627 (access to the turnbuckle is through a zippered curtain at aft end of cargo compartment). Remove clevis bolts connecting horizontal and vertical rudder cables at rudder control aft bell crank.

(2) Remove pivot bolt connecting rudder control aft bell crank to bell crank bracket. Remove bell crank.

D. Install Rudder Control Aft Bell Crank.

NOTE: Prior to installing bell crank, check bearings in bell crank two-bearing assembly for evidence of binding on bolt ratcheting, or excessive wear. Replace defective bearings (refer to 27-0, Bell Crank Bearing Installation - Typical).

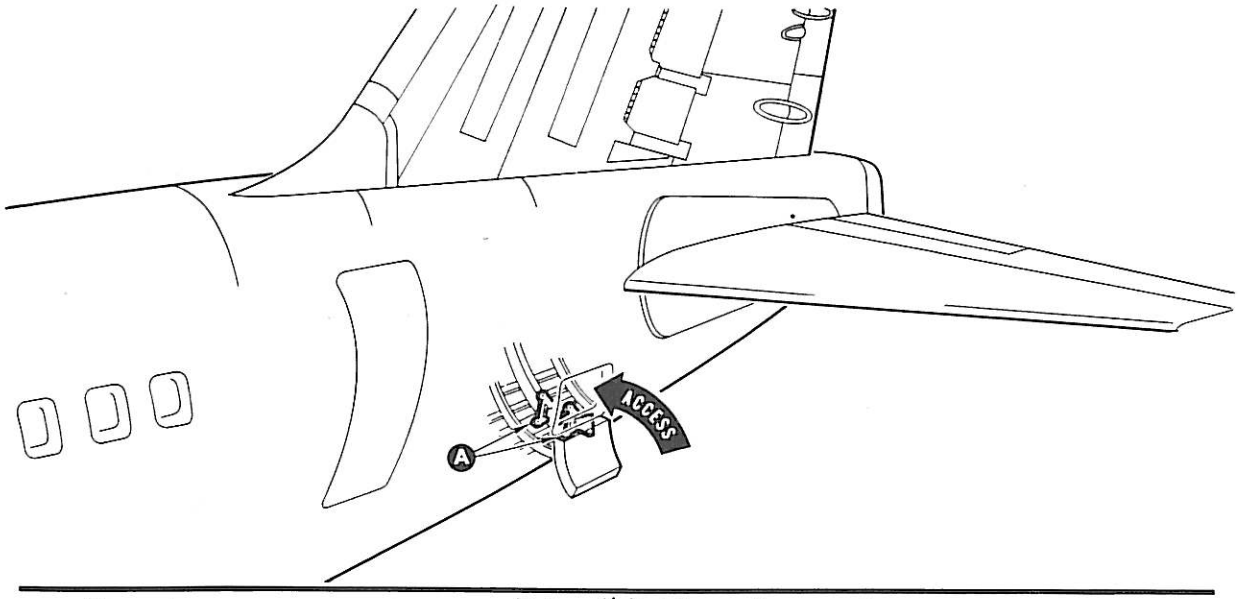
(1) Position rudder control aft bell crank and install bell crank pivot bolt.

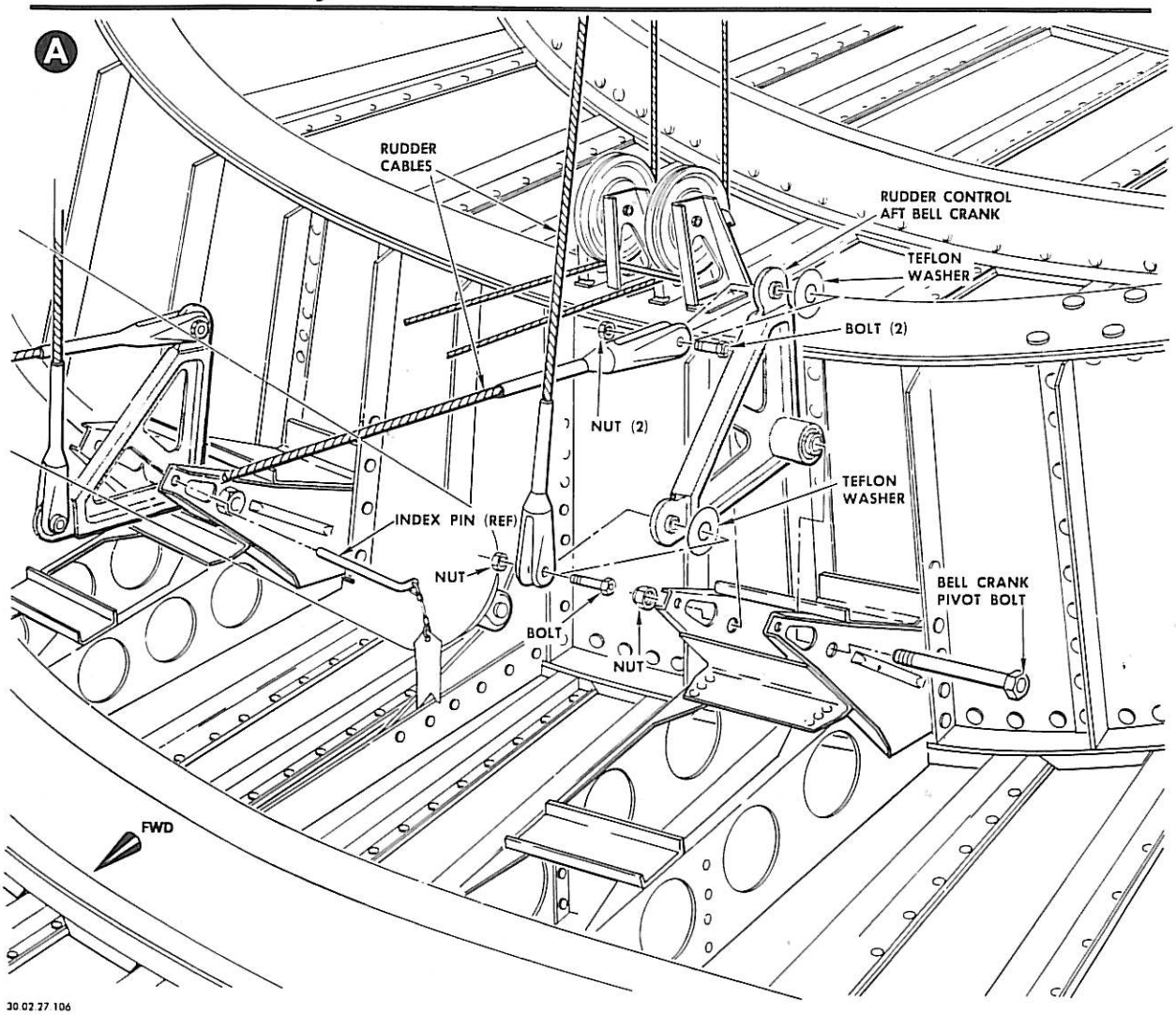
(2) Install clevis bolts connecting horizontal and vertical rudder control cables to bell crank arms.

(3) Insert index pin 22-J107-5.0 in rudder control aft bell crank on opposite side of fuselage and tighten loosened turnbuckle in rudder cable until index pin 22-J107-5.0 can be inserted in rudder control aft bell crank. If index pins 22-J107-5.0 can be inserted in both rudder control forward bell cranks at fuselage station 192, remove four index pins and safety turnbuckle in rudder cable. If not, rerig rudder control system (refer to Adjustment/Test Rudder Control System Rigging Procedure).

(4) Test system (refer to 27-7-0, Adjustment/Test Rudder Control System Functional Test).

NOTE: If a rudder control aft bell crank only has been replaced and no other rigging or adjustment has been changed, check rudder control system operation per 27-7-0, paragraph 2.E and 4.B.





Rudder Control Aft Bell Crank Installation
Figure 201

RUDDER CONTROL IDLER BELL CRANK - MAINTENANCE PRACTICES

1. Removal/Installation Rudder Idler Bell Crank (see Figure 201)

A. General.

There are two identical idler bell cranks. Removal and installation instructions are identical.

B. Equipment Required.

(1) Stand suitable for reaching lower part of vertical stabilizer.

(2) Two index pins 22-J107-3.0 and two index pins 22-J107-5.0, or equivalent.

C. Remove Rudder Idler Bell Crank.

(1) Remove lower half of rear vertical access panel on left side of vertical stabilizer.

(2) Relieve tension on rudder control cables by loosening turnbuckle on one of connecting cables and remove clevis bolts connecting turnbuckles to idler arm.

(3) Disconnect idler bell crank from bracket by removing hinge bolt.

D. Install Rudder Idler Bell Crank.

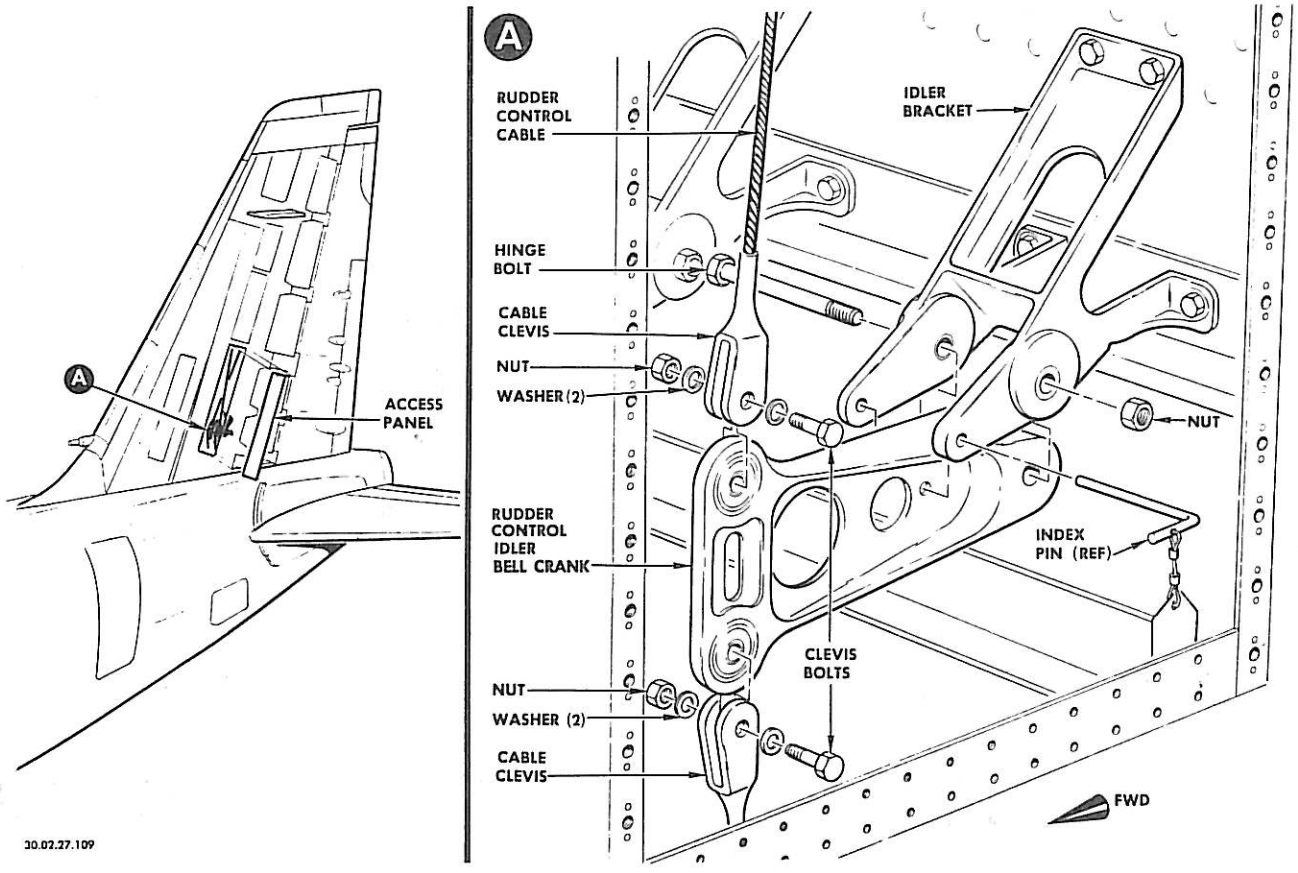
(1) Position rudder idler bell crank in bracket and install hinge bolt.

(2) Install clevis bolts connecting two turnbuckles to idler arm.

(3) Insert index pin 22-J107-3.0 in other idler and tighten loosened turnbuckle until index pin 22-J107-3.0 can be inserted in new idler. If index pins 22-J107-5.0 can be inserted in both aft rudder control cable bell cranks at station 1520, remove four index pins and safety loosened turnbuckle If not, rerig rudder control system (refer to Adjustment/Test Rudder Control System Rigging Procedure).

(4) Test system (refer to Adjustment/Test Rudder Control System Functional Test).

NOTE: If an idler bell crank only has been replaced and no other rigging or adjustment has been changed, check rudder control system operation per 27-7-0, paragraphs 2.E. and 4.B.



Rudder Control Idler Bell Crank Installation
Figure 201

RUDDER CONTROL QUADRANT BELL CRANK - MAINTENANCE PRACTICES

1. Removal/Installation Rudder Control Quadrant Bell Crank (see Figure 201)

   A. Equipment Required.

      (1) Stand suitable for reaching lower part of vertical stabilizer.

      (2) Three index pins 22-J107-3.0.

   B. Remove Rudder Control Quadrant Bell Crank.

      (1) Remove lower half of rear vertical access panel on left side of vertical stabilizer.

      (2) Remove bolt connecting vertical control rod to bell crank arm.

      (3) Loosen turnbuckle in one rudder control cable. Disconnect clevis ends of both control cables from bell crank.

      (4) Loosen turnbuckles in cables connecting autopilot servo motor to bell crank quadrants. Remove cotter pins and cables from quadrant cable grooves.

      (5) Remove shaft supporting quadrant bell crank. Remove quadrant and bell crank assembly.

   C. Install Rudder Control Quadrant Bell Crank.

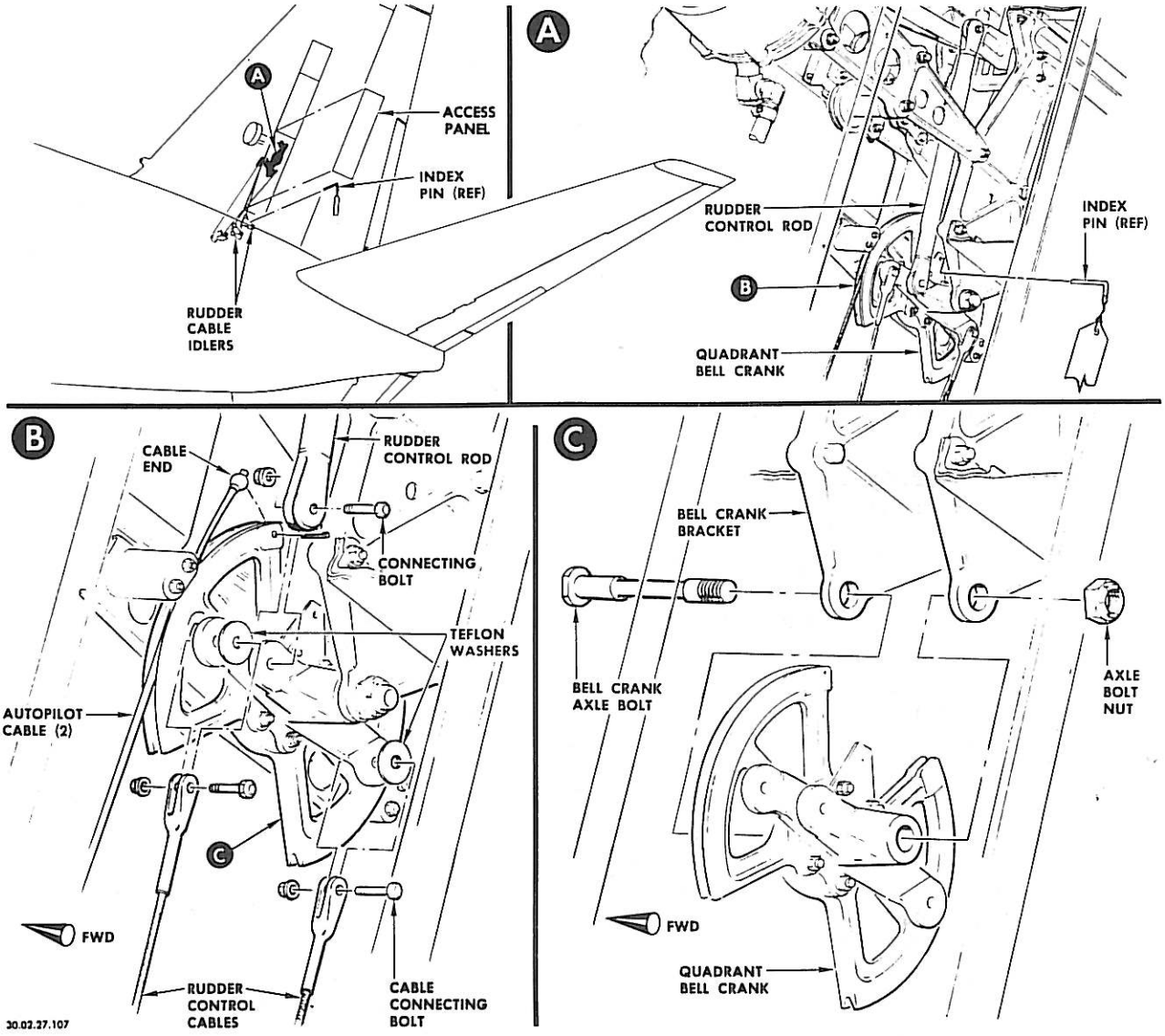
      NOTE: Prior to installing quadrant bell crank, check bearings in bell crank two-bearing assembly for evidence of binding on bolt, ratcheting, or excessive wear. Replace defective bearings (refer to 27-0, Bell Crank Bearing Installation - Typical).

      (1) Position rudder control quadrant bell crank and install bell crank shaft.

      (2) Position autopilot cables in quadrant cable grooves and install cotter pins. Rig cables (refer to 27-7-0, paragraph 1.H.).

      (3) Position clevis ends of rudder control cables on rudder cable bell crank arm and install clevis bolts.

      (4) Insert index pin 22-J107-3.0 in one idler bell crank and tighten loosened turnbuckles until a second index pin can be inserted in opposite idler bell crank. Continue adjustment until a third index pin, 22-J107-3.0, can be inserted through index tab on rudder control quadrant. Check cable tension (refer to 27-7-0, paragraph 1.E.).



Rudder Control Quadrant Bell Crank Installation
Figure 201

(5) Connect vertical control rod between quadrant bell crank arm and rudder upper bell crank.

(6) Adjust power system stops to allow control quadrant rotation of approximately 44.75 degrees each way from neutral position. Remove index pins as necessary.

(7) Remove remaining index pins, if any, and test system (refer to 27-7-0, Adjustment/Test Rudder Control System Functional Test).

NOTE: If the control quadrant bell crank only has been replaced and no other rigging or adjustment has been changed, check rudder system operation per 27-7-0, paragraphs 2.E., 2.F., and 4.B.

RUDDER UPPER AND AIR FEEL BELL CRANKS - MAINTENANCE PRACTICES

1. Removal/Installation Rudder Upper and Air Feel Bell Cranks (see Figure 201)

A. Equipment Required.

(1) Stand suitable for reaching lower part of vertical stabilizer.

(2) One index pin 22-J107-3.0 and one index pin 3/32 by 0.5 inch long.

B. Remove Rudder Upper and Air Feel Bell Cranks.

(1) Remove lower half of stabilizer aft vertical access panel. If necessary, remove upper half of access panel and vertical stringer in access opening.

(2) Remove control package access panel from right side of stabilizer at rudder hinge point No. 3 and hinge fairing plate from right side of rudder.

(3) Insert index pin 22-J107-3.0 through index tab on rudder control quadrant. Insert 3/32- by 0.5-inch index pin into rudder servo control valve.

(4) Disconnect upper control rods, leading aft to control package, from upper and air feel bell cranks.

(5) Disconnect lower control rods, leading to "Q" feel and quadrant bell cranks.

(6) Remove bell crank pivot bolt and remove bell cranks.

C. Install Rudder Upper and Air Feel Bell Cranks.

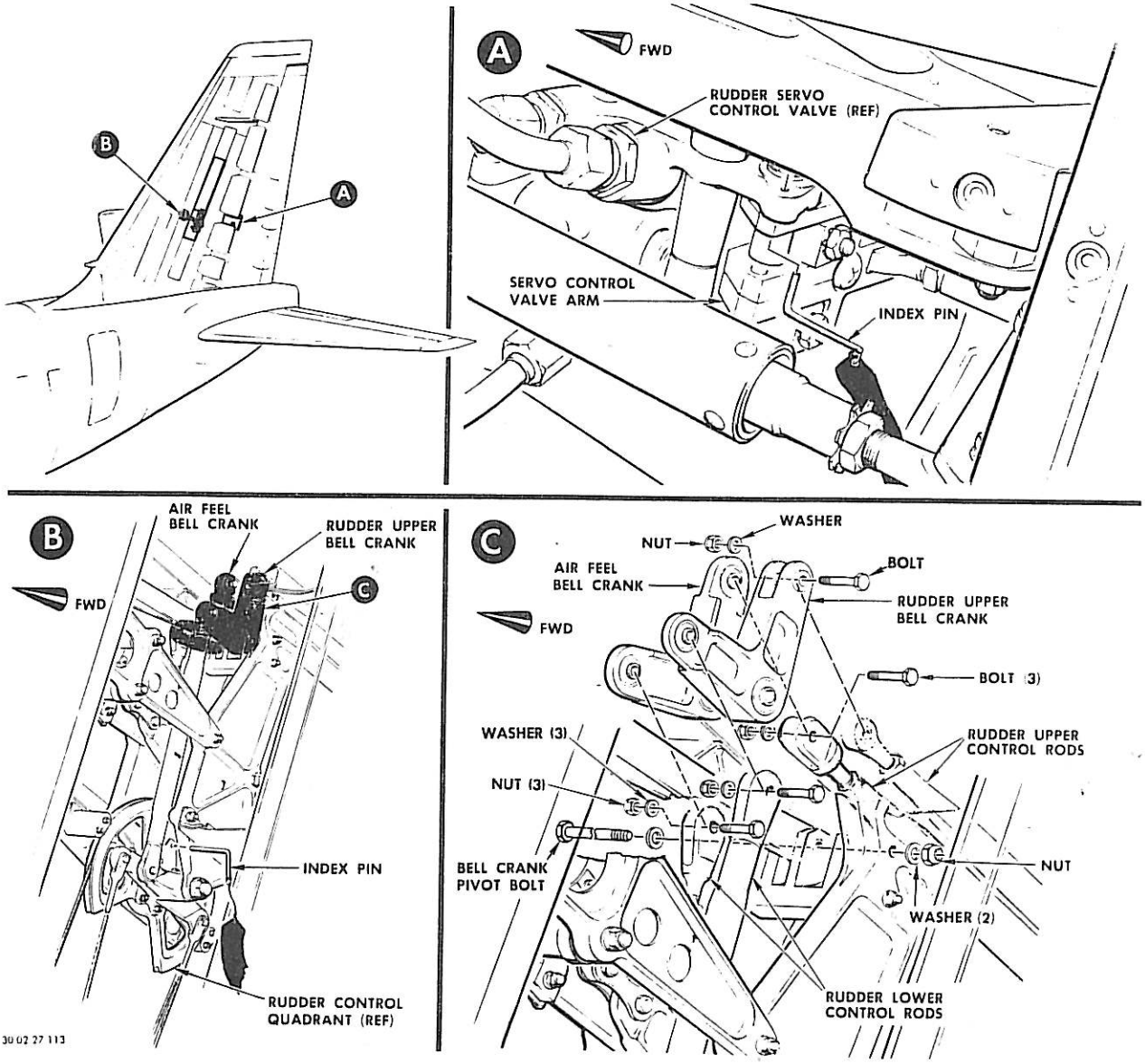
(1) Position bell cranks between supporting brackets and on opposite sides of "Q" cylinder brace. Install bell crank pivot bolt.

(2) Connect "Q" transfer rod (from "Q" feel bell crank) to lower arm of air feel bell crank.

(3) Connect fixed length vertical control rod (from control quadrant bell crank) to lower arm of rudder upper bell crank.

(4) Connect control rods from control package to upper arms of bell cranks. If connecting bolts can not be inserted easily, and without disturbing position of centering spring mechanism, proceed as follows:

(a) With index pin 22-J107-3.0 in rudder control quadrant, adjust forward end of control rods until rod end bolts can be inserted without disturbing position of centering spring mechanism.



Rudder Upper and Air Feel Bell Crank Installation
Figure 201

(b) Torque jam nuts on forward ends of control rods to between 95 and 110 inch-pounds.

(5) Remove index pins and check centering spring mechanism. Roller must be contacting both cam surfaces.

(6) Test system (refer to 27-7-0, Adjustment/Test Rudder Control System Functional Test).

NOTE: If the upper and air feel bell cranks only have been replaced and no other rigging or adjustment has been changed, check rudder control system operation per 27-7-0, paragraphs 2.E. and 4.C.

(7) Install all access panels and return airplane to normal configuration.

RUDDER "Q" FEEL BELL CRANK - MAINTENANCE PRACTICES

1. Removal/Installation Rudder "Q" Feel Bell Crank (see Figure 201)

   A. Equipment Required.

      (1) Stand suitable for reaching lower part of vertical stabilizer.

      (2) Index pin 22-J107-3.0 and one index pin 3/32 by 0.5 inch long.

   B. Remove "Q" Feel Bell Crank.

      (1) Remove lower half of stabilizer aft vertical access panel.

      (2) Remove control package LH access panel at rudder hinge support No. 3.

      (3) Insert index pin 22-J107-3.0 through index tab on rudder control quadrant.

      (4) Insert 3/32 by 0.5-inch index pin in rudder control valve in aft end of control package.

      (5) Disconnect "Q" cylinder cable link from "Q" feel bell crank arm.

      (6) Disconnect "Q" transfer rod from "Q" feel bell crank.

      (7) Remove bell crank pivot bolt and remove bell crank.

   C. Install "Q" Feel Bell Crank.

      NOTE: Prior to installing "Q" feel bell crank, check bearings in bell crank two-bearing assembly for evidence of binding on bolt, ratcheting, or excessive wear. Replace defective bearings (refer to 27-0, Bell Crank Bearing Installation - Typical).

      (1) Position bell crank between supports and install pivot bolt.

      (2) Connect "Q" cylinder cable to long arm of bell crank. Check extension of "Q" cylinder piston rod. Rod should be extended 0.4 inch from bottomed position when connected to bell crank.

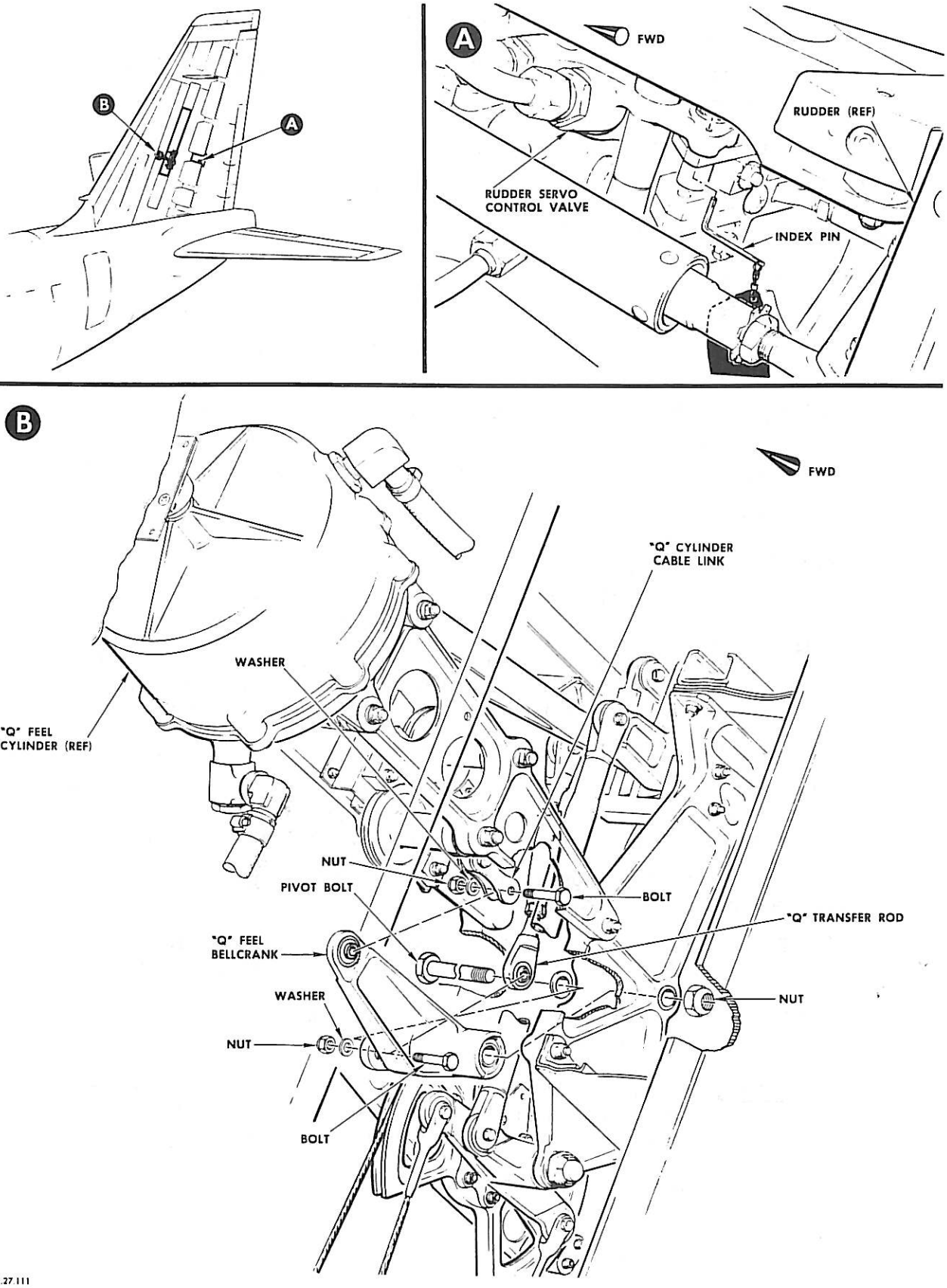
      (3) Check centering spring mechanism in control package. Roller should be in contact with both cams.

      (4) Remove index pins. If index pins bind, check rigging (refer to Adjustment/Test Rudder Control System Rigging Procedure).

      (5) Test system (refer to 27-7-0, Adjustment/Test Rudder Control System Function Test).

         NOTE: If the "Q" feel bell crank only has been replaced and no other rigging or adjustment has been changed, check rudder control system operation per 27-7-0, paragraph 4.C.

      (6) Install access panels.


B
A
A
FWD
RUDDER (REF)
RUDDER SERVO CONTROL VALVE
INDEX PIN
B
FWD
"Q" CYLINDER CABLE LINK
WASHER
"Q" FEEL CYLINDER (REF)
NUT
PIVOT BOLT
BOLT
"Q" TRANSFER ROD
"Q" FEEL BELLCRANK
WASHER
NUT
NUT
BOLT
30.02.27.111

(5) Install two bolts to attach top corners of "Q" cylinder supports and forward end of "Q" cylinder brace to back side of "Q" cylinder.

(6) With "Q" cylinder piston bottomed, make a reference mark on piston rod (extending from aft side of cylinder).

(7) Connect "Q" cylinder cable link to arm of "Q" feel bell crank. Check position of reference mark. Piston rod should be extended 0.4 inch when connected.

(8) Connect static and dynamic air lines to "Q" cylinder fittings. Dynamic (ram air) is connected to lower aft fitting.

(9) Test system (refer to 27-7-0, Adjustment/Test Rudder Control System Functional Test).

NOTE: If the rudder "Q" cylinder only has been replaced and no other rigging or adjustment has been changed, check rudder control system operation per 27-7-0, paragraph 4.C.

(10) Install vertical stringer in access opening and install access panel.

(5) Install two bolts to attach top corners of "Q" cylinder supports and forward end of "Q" cylinder brace to back side of "Q" cylinder.

(6) With "Q" cylinder piston bottomed, make a reference mark on piston rod (extending from aft side of cylinder).

(7) Connect "Q" cylinder cable link to arm of "Q" feel bell crank. Check position of reference mark. Piston rod should be extended 0.4 inch when connected.

(8) Connect static and dynamic air lines to "Q" cylinder fittings. Dynamic (ram air) is connected to lower aft fitting.

(9) Test system (refer to Adjustment/Test Rudder Control System Functional Test).

(10) Install vertical stringer in access opening and install access panel.

RUDDER CONTROL PACKAGE - MAINTENANCE PRACTICES

1. Removal/Installation Rudder Hydraulic Servo Control Valve (see Figure 201)

A. General.

The following procedure may be used to remove the rudder hydraulic servo control valve when maintenance is not being performed which requires removal of vertical stabilizer access panels and/or disconnecting rudder trim control cables.

B. Equipment Required.

(1) Stands suitable for reaching both sides of vertical stabilizer.

(2) External source of ac electrical power.

(3) External source of hydraulic power.

(4) Tool 30-15000-901 #1 to secure rudder in streamline position and to measure rudder travel.

(5) Tool 30-15000-901 RGTL #2 to measure rudder flight tab travel.

C. Remove Servo Control Valve.

WARNING: RUDDER HYDRAULIC CONTROL SYSTEM MUST BE DEPRESSURIZED AND CONTROL SWITCHES TURNED OFF WHEN MAINTENANCE IS BEING PERFORMED ON THE RUDDER OR IN THE AREA OF RUDDER TRAVEL.

(1) Open HYDRAULIC PUMP MOTOR CONTROL circuit breaker on main circuit breaker panel.

(2) Depressurize rudder hydraulic system by turning ON power rudder control switches and deflecting rudder until rudder stops operating hydraulically. Turn power rudder control switches OFF.

WARNING: POWER RUDDER CONTROL CIRCUIT BREAKERS ON MAIN CIRCUIT BREAKER PANEL MUST BE CLOSED AT ALL TIMES WHEN WORKING ON RUDDER OR VERTICAL STABILIZER.

(3) Remove access panels from each side of stabilizer at rudder hinge No. 3.

(4) Remove rudder hinge fairing plates at rudder hinge No. 3.

(5) On left side of stabilizer, remove bracket from aft end of rib between control package and rudder actuators. Remove vertical channel at aft end of opening.

(6) Remove vertical channel at forward end of opening to avoid damaging hydraulic lines.

(7) Disconnect spring-cartridge control rod from control valve bell crank.

CAUTION: TAPE SPRING-CARTRIDGE CONTROL ROD END BEARING TO PREVENT BEARING FROM TURNING AND POSSIBLE DAMAGE TO BEARING.

(8) Disconnect rudder flight tab control rods from bell cranks at aft end of rudder control package.

(9) Disconnect hydraulic lines from servo control valve.

(10) Unclamp servo control valve hydraulic lines on left side at midpoint of rudder control package.

(11) Disconnect short input link to servo control valve.

(12) Disconnect rudder flight tab upper and lower bell cranks at aft left side of rudder control package at support assemblies.

(13) Remove lower center union fitting from right side of rudder hydraulic servo control valve.

(14) Remove flight tab lower link support assembly mounting bolts and remove support assembly from control package.

(15) Remove rudder control package mounting bolts. Position package to left and down.

CAUTION: USE CARE TO AVOID DAMAGE TO HYDRAULIC LINES.

(16) Move rudder trailing edge full travel right. Remove nuts from control valve mounting bolts, push bolts up as far as possible, and remove control valve through left side of control package.

(17) Remove union fittings from control valve.

D. Install Servo Control Valve.

(1) Install new "O" rings on union fittings, and install fittings in new servo control valve.

NOTE: Do not install right-hand lower middle fitting.

(2) Position control valve in rudder control package through left side. Lower control valve mounting bolts and secure with nuts.

(15) Deflect rudder to right and remove control valve bell crank pivot bolt from leading edge of rudder.

(16) Remove three control package mounting bolts and lower control package to stabilizer rib directly below package. Make sure that all clips and brackets are removed that might cause interference with control package removal. Check that all tubes, wiring and controls have been disconnected. Slide package, aft end first, out of opening in left side of stabilizer.

CAUTION: USE CARE IN REMOVING CONTROL PACKAGE TO AVOID DAMAGE TO HYDRAULIC LINES AND FITTINGS.

C. Install Rudder Control Package.

(1) Check length of control valve centering rod connected to LH end of control valve bell crank before starting to install control package. Rod should measure approximately 25 inches between centers of rod end bearings.

(2) Support control package near opening on left side of stabilizer, and route rudder flight tab trim cables down through stabilizer and into tail cone. Install cable guards.

(3) Position control package in stabilizer and install three package mounting bolts. Torque hollow bolts to between 240 and 270 inch-pounds.

CAUTION: USE CARE IN POSITIONING CONTROL PACKAGE TO AVOID DAMAGE TO HYDRAULIC LINES AND FITTINGS.

NOTE: Prior to installing pivot bolt in the following step, check bearings in control valve bell crank two-bearing assembly for evidence of binding on pivot bolt, ratcheting, or excessive wear. Replace defective bearings (refer to 27-0, Bell Crank Bearing Installation - Typical).

(4) Install control valve bell crank pivot bolt. Bell crank pivots on lug on forward side of rudder leading edge spar.

(5) Connect hydraulic lines on RH side of control package.

(6) Install and connect hydraulic lines to "T" fittings at aft right side of control package.

(7) Install tool 30-15000-901 RGTL #1 and secure rudder in streamline position.

(8) Install tool 30-15000-901 RGTL #2 to measure rudder flight tab deflection (see 27-7-0, Figure 203).

(9) Install angles removed in step B. (7).

(10) Install and connect hydraulic lines on LH side of control package, and install vertical channel and bracket at aft end of opening.

(11) Adjust flight tab control rods as necessary to streamline flight tab without moving centering spring mechanism. Lockout arm must remain at left end of track slot during adjustment.

(12) Disconnect aft ends of lockout cylinders in left side of control package and swing lockout arm to right end of track slot.

(13) Insert index pin 22-J107-3.0 through index tab on rudder control quadrant.

(14) Connect dry air or nitrogen source to "Q" cylinder ram air connection (lower aft connection). Pressurize "Q" cylinder to 10 inches mercury.

(15) Adjust length of RH control rod to connect to upper arm of air feel bell crank. Control rod must be connected without displacing bell crank and without moving centering spring mechanism.

(16) Adjust length of LH control rod to connect to rudder upper bell crank. Control rod must be connected without moving centering spring mechanism.

(17) Attempt to insert 3/32 x 0.5-inch index pin in control valve. If pin does not fit freely, adjust link between control valve and control valve bell crank or centering rod so that index pin fits freely and control valve bell crank is approximately parallel with forward surface of rudder leading edge spar. Make sure that centering spring mechanism is free to center on cam when inserting index pin.

(18) Make sure that flight tab trim jack is in neutral position; cables should extend same distance into tail cone. Make sure that pilot's rudder trim knob is at 0-degree position.

(19) Connect rudder power trim cables in tail cone. Adjust cable tension (refer to 27-8-0, Adjustment/Test Rudder Trim System Rigging Procedure).

(20) Check cable rigging as follows:

(a) Tension of power and manual trim cables must be equal.

(b) Pilots' rudder trim knob must remain at 0-degree position.

(c) Clevises on manual trim jack must extend aft 1.35 (±0.03) inches, measured between clevis hole center and housing of trim jack.

NOTE: Measurement shall be 1.45 (±0.03) inches on trim jacks not modified per Service Bulletin A27-29A.

(d) Clevis on power trim jack must extend aft 2.45 (±0.03) inches, measured between clevis hole center and housing of trim jack.

(e) Rudder trim tab and rudder flight tab must be at 0-degree position.

(f) Ends of each pair of trim cables must be even with each other so that actuators are at mid-travel. The two cables on each trim jack are of equal length (see 27-8-3, Figure 201).

(21) Swing lockout arm back to left end of track slot and connect lockout cylinders to bell cranks.

(22) Connect electrical connector to manual mode switch on RH side of control package.

(23) Make sure that electrical connection, hydraulic lines, and controls are connected and secure. Remove rigging tool surface locks, leaving protractor parts of tools installed so that rudder and flight tab travel can be measured.

(24) Bleed hydraulic system (refer to 27-7-0, Adjustment/Test Rudder Control System Bleeding Procedure).

(25) Close MANUAL RUDDER MODE WARN circuit breaker and test system (refer to 27-7-0, Adjustment/Test Rudder Control System Functional Test).

NOTE: If the rudder control package only has been replaced and no other rigging or adjustment has been changed, check rudder control system operation per 27-7-0, paragraphs 2.C., 2.E., 2.F., 3.B., 4.B., and 4.C.

(26) Close all access doors, install all access panels, remove rigging tools and return airplane to normal configuration.

RUDDER CONTROL SYSTEM SHUTOFF VALVE - MAINTENANCE PRACTICES

1. Removal/Installation Rudder Control System Shutoff Valve (see Figure 201)

A. Equipment Required.

(1) Stand or ladder suitable for reaching and entering tail cone forward access door.

(2) Drip pan to catch spilled hydraulic fluid.

(3) External source of hydraulic power.

(4) External source of electrical power.

B. General.

There are two rudder control systen shutoff valves located in the tail cone. The two valves are mounted high on the forward side of the bulkhead opposite the tail cone forward access door. Hydraulic system No. 1 valve is on the LH side, and system No. 2 valve is on the RH side.

C. Remove Rudder Control System Shutoff Valve.

(1) Open tail cone forward access door.

(2) Position drip pan to catch any spilled hydraulic fluid.

(3) Open SYS 1 and SYS 2 - POWER RUDDER CONTROL circuit breakers.

(4) Depressurize hydraulic system from which valve is to be removed (refer to Chapter 12, SERVICING).

(5) Disconnect electrical connector from valve electrical outlet.

(6) Disconnect hydraulic line from each side of valve. Cap lines and wipe up spilled hydraulic fluid.

(7) Remove two valve mounting bolts and remove valve from mounting bracket.

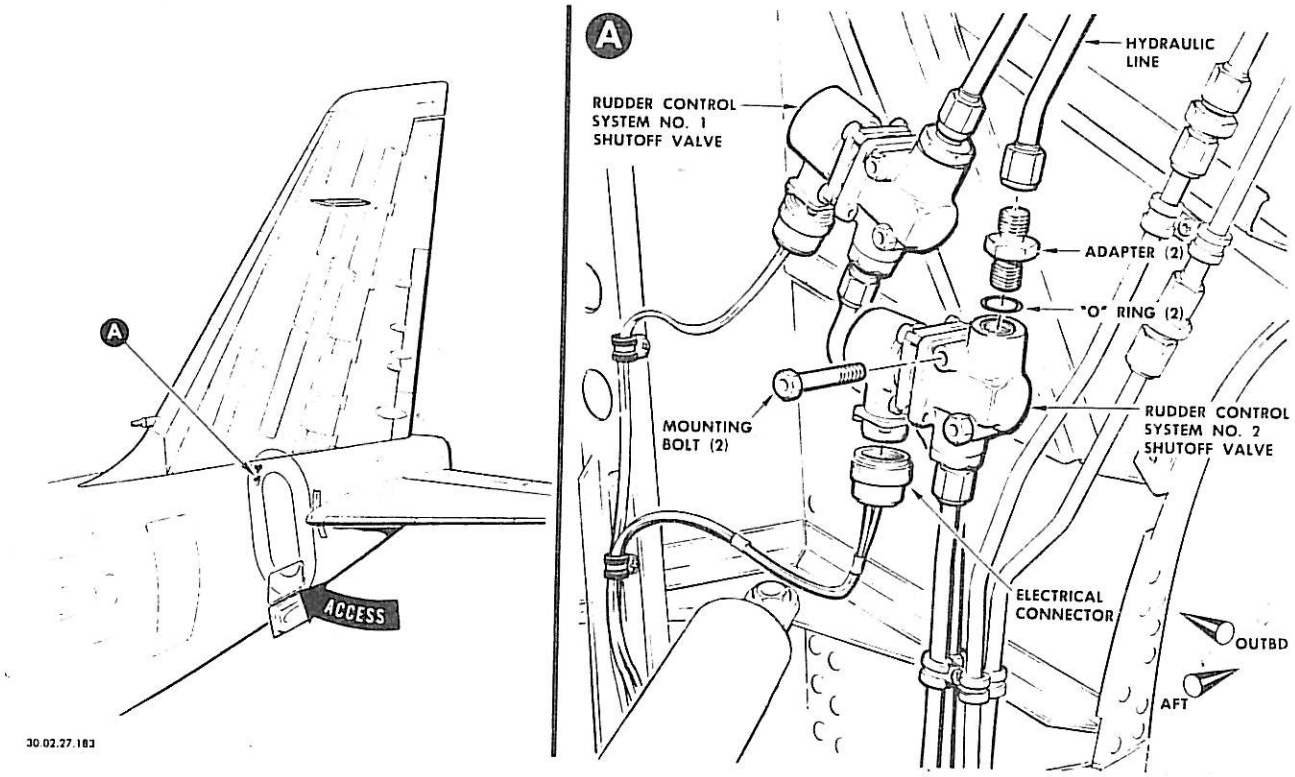
D. Install Rudder Control System Shutoff Valve.

(1) Position valve on mounting bracket and install two mounting bolts.

(2) Connect hydraulic line at each side of valve.

(3) Connect electrical connector at valve electrical outlet.

(4) Bleed rudder control hydraulic system (refer to Adjustment/Test Rudder Control System Bleeding Procedure).



Rudder Control System Shutoff Valve Installation
Figure 201

(5) Close SYS 1 and SYS 2 - POWER RUDDER CONTROL circuit breakers and test system (refer to 27-7-0, Adjustment/Test Rudder Control System Functional Test).

NOTE: If a system shut off valve only has been replaced and no other rigging or adjustment has been changed, check rudder control system operation per 27-7-0, steps 3.B.(17), and 3.B.(21) through 3.B.(28).

(6) Clean up any spilled hydraulic fluid and close tail cone access door.

RUDDER CONTROL BYPASS SHUTOFF VALVE - MAINTENANCE PRACTICES

1. Removal/Installation Rudder Control Bypass Shutoff Valve (see Figure 201)

A. Equipment Required.

(1) Stand suitable for reaching the upper half of vertical stabilizer.

(2) Drip pan to catch spilled hydraulic fluid.

(3) External source of hydraulic power.

(4) External source of electric power.

B. General.

Two rudder control bypass shutoff valves are mounted on the forward side of vertical stabilizer spar No. 3. Access to the valves is gained by removing the third section (first section is at bottom of stabilizer) of the stabilizer vertical access panel.

C. Remove Rudder Control Bypass Shutoff Valve.

(1) Depressurize hydraulic system from which valve is to be removed (refer to Chapter 12, SERVICING).

(2) Open associated POWER RUDDER OFF circuit breaker.

(3) Remove third section from bottom of stabilizer vertical access panel.

(4) Disconnect electrical connector from valve electrical outlet.

(5) Position drip pan beneath valve to catch spilled hydraulic fluid.

(6) Disconnect hydraulic line from each side of valve.

(7) Remove two valve mounting bolts and remove valve from mounting bracket.

(8) Cap hydraulic lines to prevent entry of foreign materials and wipe up any spilled hydraulic fluid.

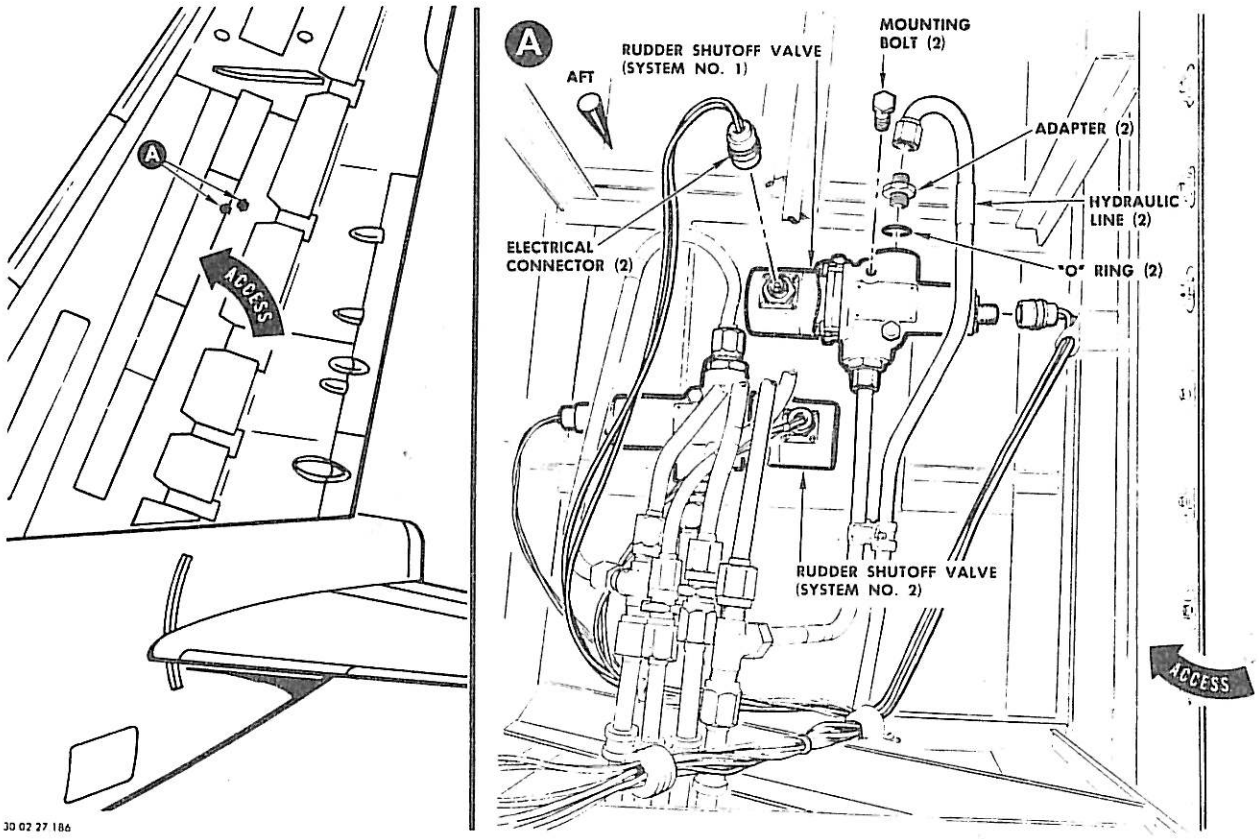
D. Install Rudder Control Shutoff Valve.

(1) Position valve on mounting bracket and install two attaching bolts.

(2) Connect hydraulic lines to valve inlet and outlet ports.

(3) Connect electrical connector to valve electrical outlet.

(4) Close associated RUDDER POWER OFF circuit breaker.



Rudder Control Bypass Shutoff
Valve Installation
Figure 201

(5) Bleed rudder control hydraulic system (refer to 27-7-0, Adjustment/ Test Rudder Control System Bleeding Procedure).

(6) Test system (refer to 27-7-0, Adjustment/Test Rudder Control System Functional Test).

NOTE: If a bypass shutoff valve only has been replaced and no other rigging or adjustment has been changed, check rudder control system operation per 27-7-0, steps 3.B.(1) through 3.B.(21).

(7) Clean up any spilled hydraulic fluid and install access panel.

RUDDER CONTROL BYPASS RELIEF VALVE - MAINTENANCE PRACTICES

1. Removal/Installation Rudder Control Hydraulic Relief Valve (see Figure 201)

A. Equipment Required.

(1) Stand suitable for reaching upper half of vertical stabilizer.

(2) Drip pan to catch spilled hydraulic fluid.

(3) External source of hydraulic power.

(4) External source of electric power.

B. General.

Four rudder control hydraulic relief valves are mounted on the forward side of vertical stabilizer spar No. 3. Access to the valves is gained by removing the third section (first section is at bottom of stabilizer) of the stabilizer vertical access panel.

C. Remove Rudder Control Bypass Relief Valve.

(1) Depressurize hydraulic system from which valve is to be removed (refer to Chapter 12, SERVICING).

(2) Remove third section, from bottom, of vertical access panel.

(3) Position drip pan beneath valve to catch spilled hydraulic fluid.

(4) Disconnect hydraulic line from each end of relief valve.

(5) Remove two screws attaching two mounting clamps to stabilizer spar and remove valve.

(6) Cap ends of hydraulic lines to prevent entry of foreign materials and wipe up spilled hydraulic fluid.

D. Install Rudder Control Bypass Relief Valve.

(1) Position valve against forward side of stabilizer spar No. 3, align mounting clamps with screw holes, and install one screw through each clamp.

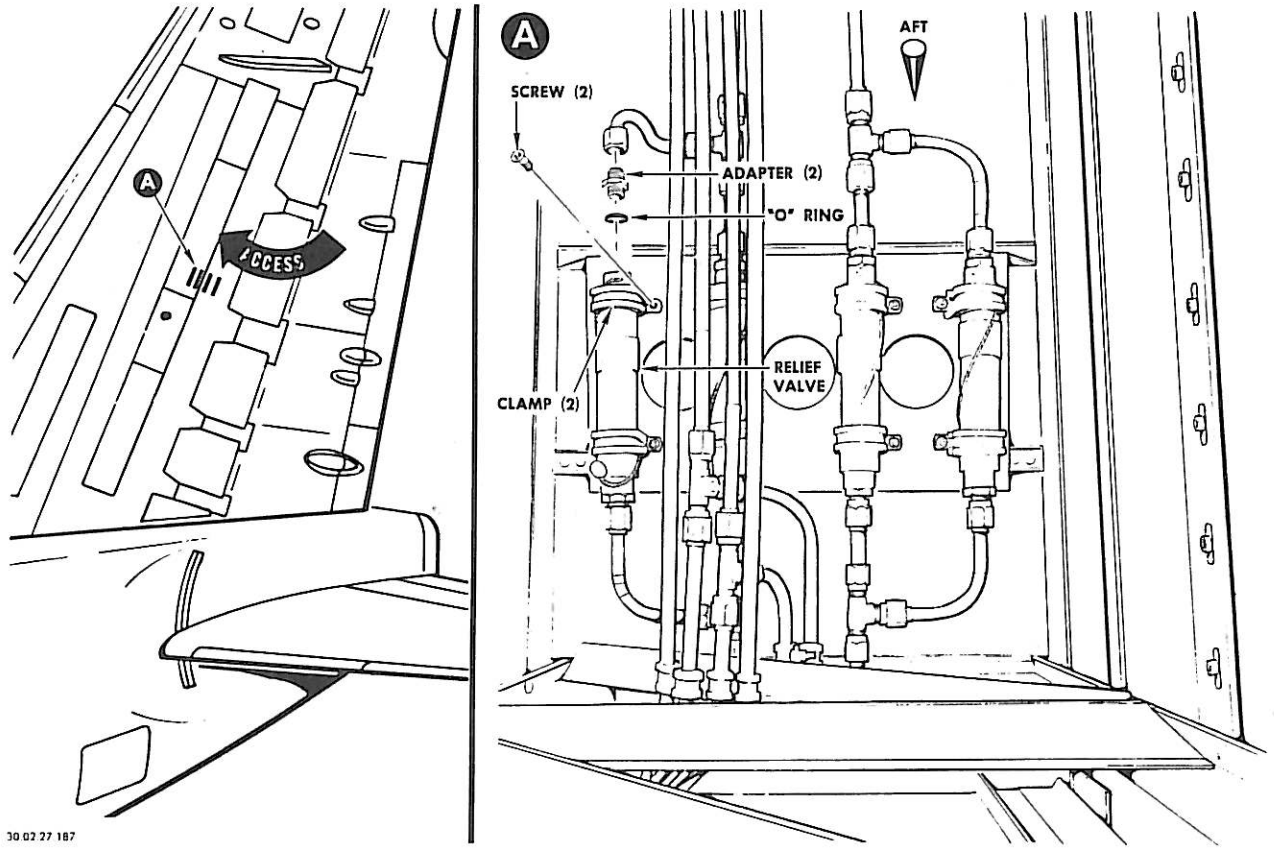
(2) Connect hydraulic lines to valve inlet and outlet ports.

(3) Bleed rudder control hydraulic system (refer to 27-7-0, Adjustment/ Test Rudder Control System Bleeding Procedure).

(4) Test system (refer to 27-7-0, Adjustment/Test Rudder Control System Functional Test).

NOTE: If a bypass relief valve only has been replaced and no other rigging or adjustment has been changed, rudder control system operational check is not necessary.

(5) Wipe up spilled hydraulic fluid, install access panel, and return airplane to normal configuration.



Rudder Control Hydraulic Relief Valve Installation
Figure 201

RUDDER CONTROL LOW PRESSURE SWITCHES - MAINTENANCE PRACTICES

1. Removal/Installation Rudder Control Low Pressure Switches (see Figure 201)

A. Equipment Required.

(1) Stand suitable for reaching upper half of vertical stabilizer.

(2) Drip pan to catch spilled hydraulic fluid.

(3) External source of hydraulic power.

(4) External source of electric power.

B. General.

Two pressure switches are installed forward of vertical stabilizer spar No. 3. The pressure switches are accessible when the third section, from the bottom, of the stabilizer vertical access panel is removed. The switches are mounted on the underside of the rib nearest the bottom of the access opening.

C. Remove Rudder Control Low Pressure Switch.

(1) Depressurize hydraulic system from which pressure switch is to be removed (refer to Chapter 12, SERVICING).

(2) Open associated RUDDER POWER OFF circuit breaker.

(3) Remove third section, from bottom, of stabilizer vertical access panel.

(4) Disconnect electrical connector from switch electrical outlet.

(5) Position drip pan beneath pressure switch being removed.

(6) Disconnect hydraulic line from switch pressure port. Cap disconnected line to prevent entry of foreign materials.

(7) Remove two bolts, and nuts, attaching switch to stabilizer rib.

(8) Remove screw attaching two clamps to rib and remove switch.

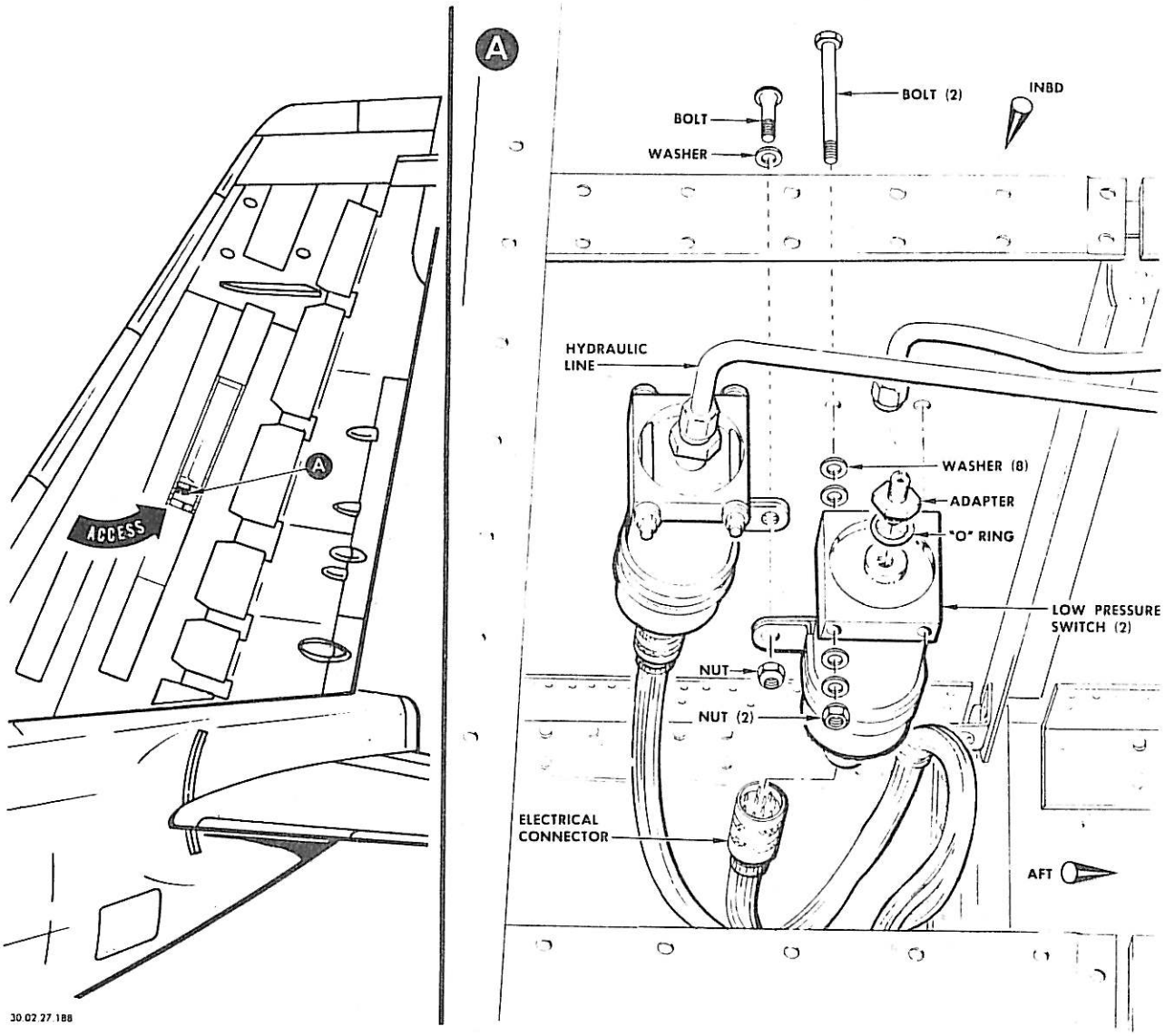
(9) Wipe up spilled hyraulic fluid.

D. Install Rudder Control Low Pressure Switch.

(1) Position pressure switch against underside of rib and loosely install screw to attach clamps to rib.

(2) Install two pressure switch mounting bolts and tighten clamp screw.

(3) Connect hydraulic line to pressure switch pressure port.



Rudder Control Low Pressure Switch Installation
Figure 201

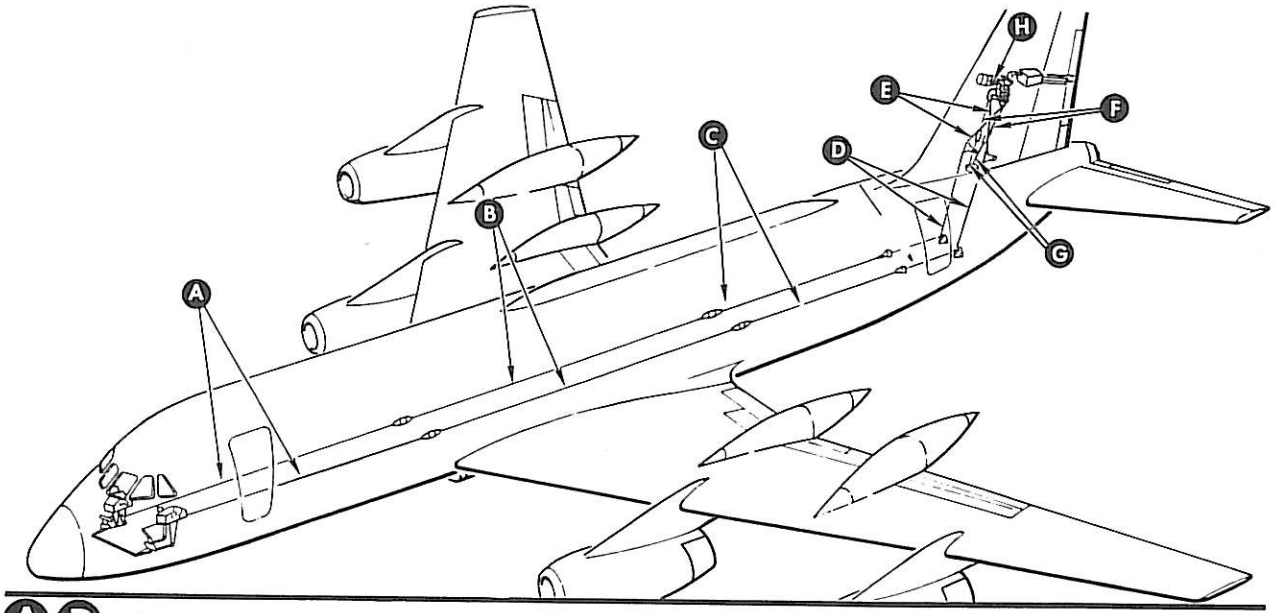
(4) Connect electrical connector to switch electrical outlet.

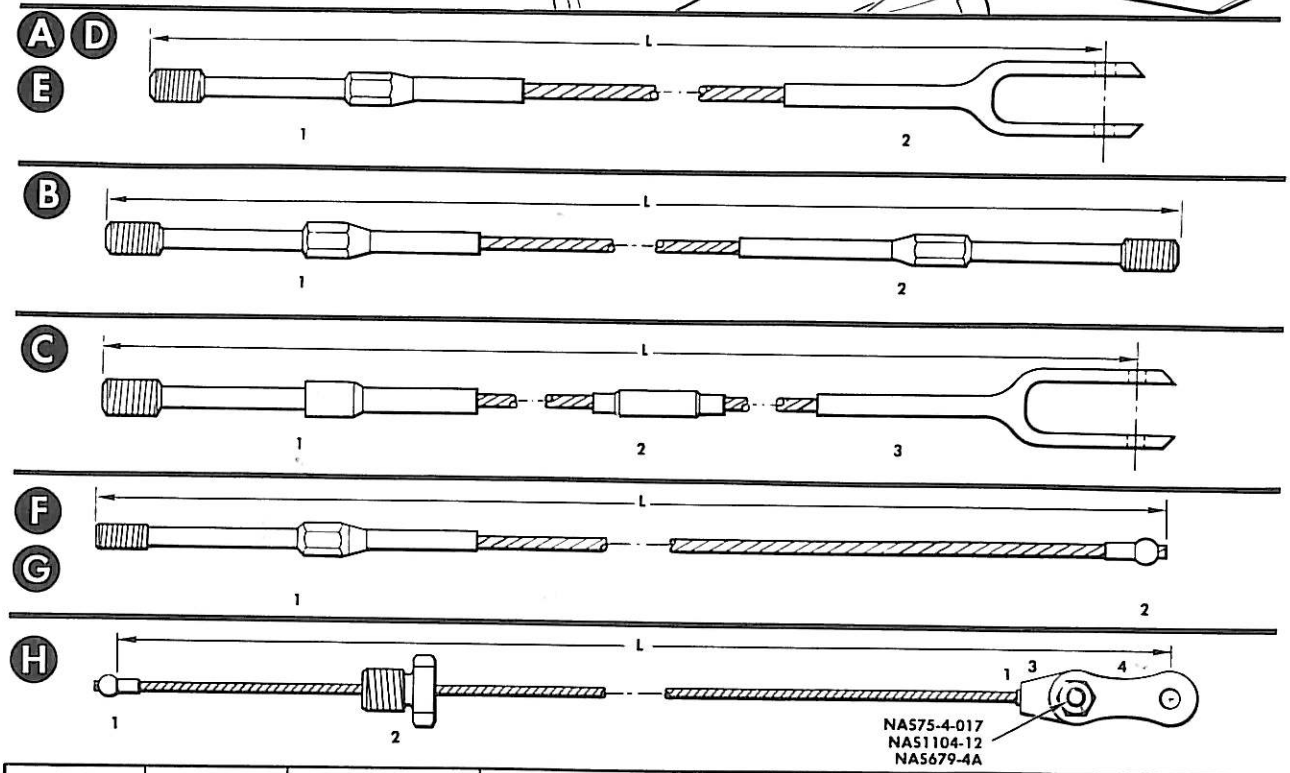
(5) Bleed rudder control hydraulic system (refer to 27-7-0, Adjustment/ Test Rudder Control System Bleeding Procedure).

(6) Test system (refer to 27-7-0, Adjustment/Test Rudder Control System Functional Test).

NOTE: If a low pressure switch only has been replaced and no other rigging or adjustment has been changed, check rudder control system operation per 27-7-0, steps 3.B.(1) through 3.B.(21).

(7) Clean up any spilled hydraulic fluid, install access panel, and return airplane to normal configuration.





CABLE REFERENCE	NUMBER REQUIRED	LENGTH	CABLE SIZE	FITTINGS 1	2	3	4
A	2	433.65	1/8 X 1 X 19	NAS650-L4RH	AN658-4		
B	2	447.70	1/8 X 1 X 19	NAS650-L4RH	NAS650-L4LH		
C	2	441.30	1/8 X 1 X 19	22-40918	22-40911-591	22-40914-7	
D	2	95.25	1/8 X 1 X 19	NAS650-L4LH	22-40914-7		
E	2	57.35	1/8 X 1 X 19	NAS650-L4LH	AN658-4		
F	2	43.50	1/8 X 7 X 19	NAS650-S4LH	AN664-C4		
G	2	66.30	1/8 X 7 X 19	NAS650-S4RH	AN664-C4		
H	1	10.25	3/32 X 7 X 7	AN 664-C3	30-46428-7	30-46429-7	22-46261(2)

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RUDDER "Q" CYLINDER RAM AIR INLET - MAINTENANCE PRACTICES

1. Removal/Installation Rudder "Q" Cylinder Ram Air Inlet

   A. Equipment Required - Stand suitable for reaching lower part of vertical stabilizer.

   B. Remove Ram Air Inlet.

      (1) Open RUDDER FEEL PITOT HTR circuit breaker on main circuit breaker panel.

      (2) Remove screws attaching ram air inlet and attaching panel to vertical stabilizer.

      (3) Pull straight forward on ram air inlet and panel until ram air inlet clears ram air line and ram air inlet heater wiring terminal strip is accessible.

      (4) Disconnect ram air inlet heater wiring at terminal strip.

      (5) Remove ram air inlet-to-panel attaching screws and remove inlet.

   C. Install Ram Air Inlet.

      (1) With ram air inlet panel removed from vertical stabilizer, install ram air inlet in panel.

          NOTE: Drain hole in ram air inlet must be on lower side of inlet.

      (2) Connect ram air inlet heater wiring at terminal strip.

      (3) Position ram air inlet and panel on vertical stabilizer with air line inserted in ram air inlet; install attaching screws.

      (4) Close RUDDER FEEL PITOT HTR circuit breaker on main circuit breaker panel.

      (5) Check operation of rudder "Q" cylinder ram air inlet heater (refer to Chapter 30, ICE AND RAIN PROTECTION).

RUDDER TRIM SYSTEM - DESCRIPTION AND OPERATION

1. General

Directional trim is adjusted by a rudder trim knob on the pilots' pedestal (see Figure 1). The trim knob is connected by gears, cables, and push-pull rods to the rudder trim tab and the hydraulic servo control valve in the rudder control power package. A gear on the trim knob shaft drives the rudder trim indicator while a bevel gear at the bottom of the shaft drives the forward trim cable drum. Two trim cables extend aft from the forward cable drum beneath the cabin floor, through pressure seals, around pulleys, and up into the vertical stabilizer where each cable joins a pair of cables to form two parallel cable circuits. One pair of cables extend upward to the manual mode trim jack which is connected by push-pull rods to the rudder trim tab. The other pair of cables extend upward to the power mode trim jack which is connected by levers and a push-pull rod to the servo control valve in the power package.

In the power mode of operation, rotation of the trim knob to the right causes a limited right rudder deflection by introducing a bias into the rudder controls through a whiffletree linkage in the rudder control package. This causes a shift from neutral in the rudder servo valve, resulting in a corresponding rudder displacement for right rudder trim. The manual trim jack operates simultaneously with the power trim jack and the rudder trim tab is deflected to the left (RH rotation of trim knob). Aerodynamic forces acting on the trim tab assist in deflecting the rudder to the right.

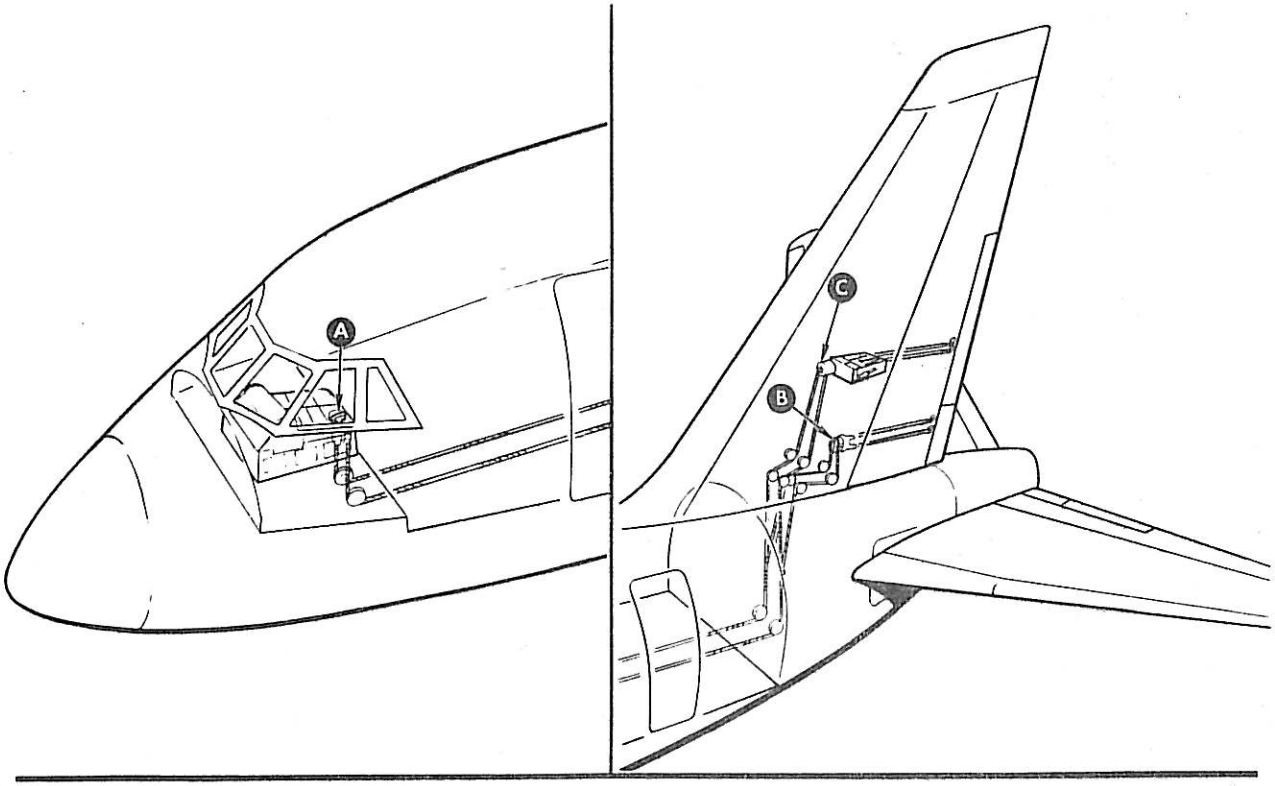
In the manual mode of operation, the operation of the power trim jack is ineffective and rudder trim is effected solely by the action of the rudder trim tab.

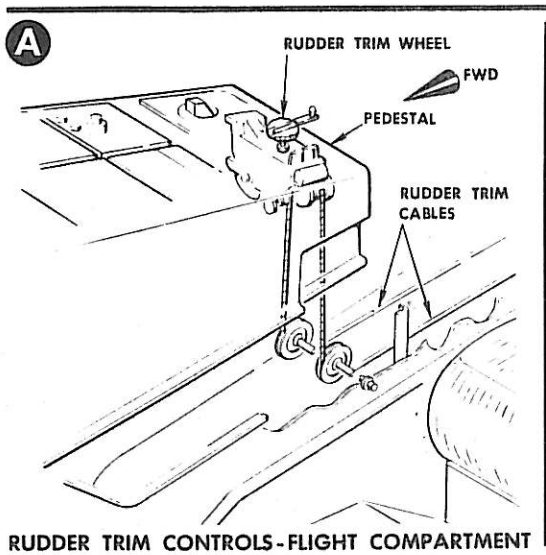
2. Rubber Trim and Trim Tab Travel

During power mode rudder operation, full travel of the rudder trim control knob on the pilots' pedestal deflects the rudder 6-1/2 degrees left or right from the streamline position and also moves the rudder trim tab 23 degrees from streamline in the opposite direction. During manual operation, with no hydraulic pressure, full travel of the rudder trim control knob will deflect the rudder trim tab 23 degrees left or right from streamline.

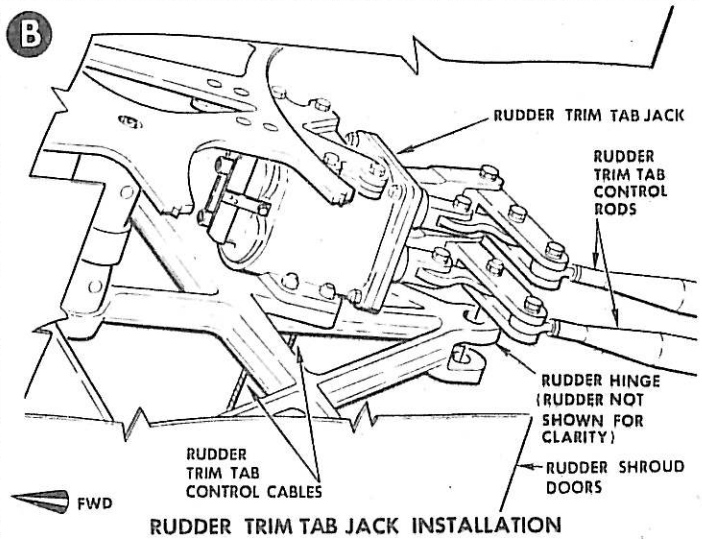
3. Rudder Trim and Trim Tab Control

Rotation of the rudder trim knob trims the rudder in both the power and manual modes. The trim knob is mechanically connected to the power mode trim jack and the manual trim jack. Actuation of the power mode trim jack positions the center bell crank in mixer No. 1, which transmits motion through a control rod to the hydraulic servo control valve bell crank and moves the rudder to the right or left of the streamlined position. The rudder trim tab travel is controlled by direct linkage with the manual trim jack.

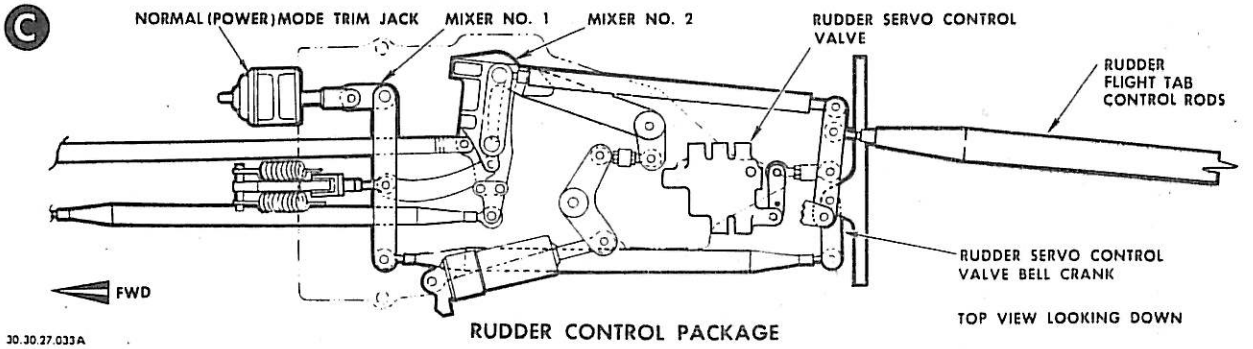




RUDDER TRIM CONTROLS - FLIGHT COMPARTMENT



RUDDER TRIM TAB JACK INSTALLATION



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RUDDER CONTROL PACKAGE

4. Rudder Trim Tab

The rudder trim tab is located at the trailing edge of the rudder directly below the flight tab. The trim tab is of all aluminum sandwich-type construction with 0.02-inch, 2024 skins and 5052 honeycomb core. Three hinges are provided for attachment to the rudder.

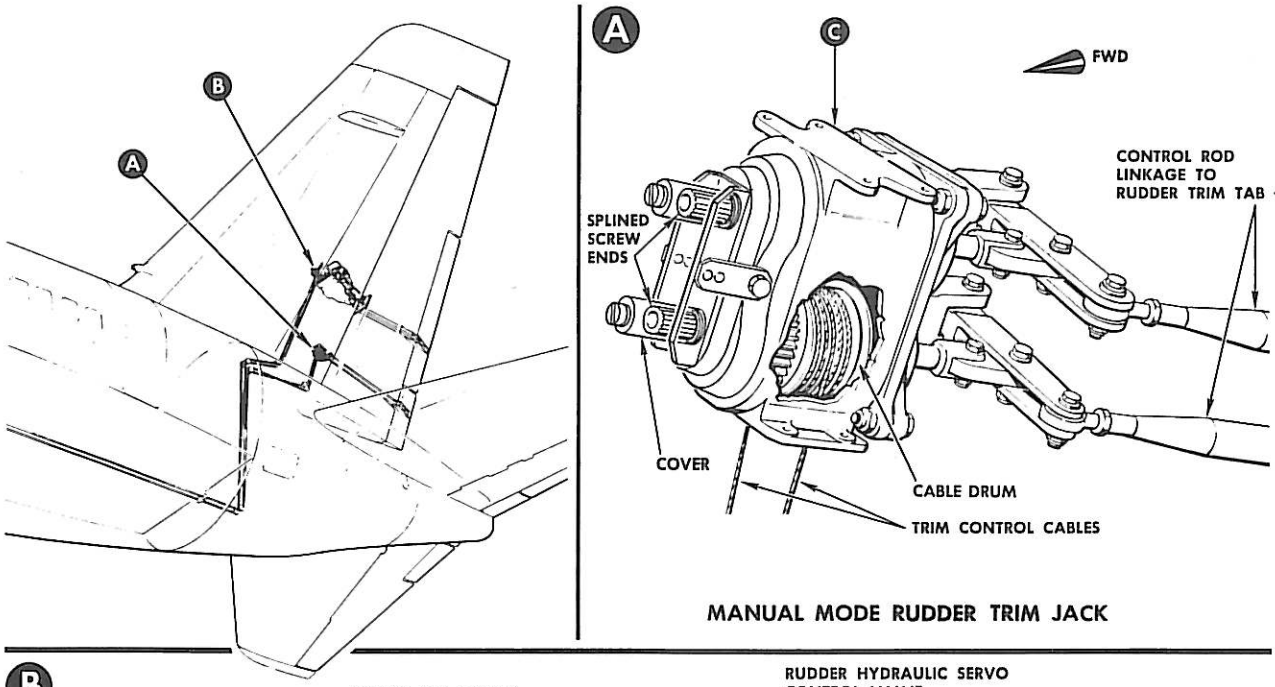
5. Rudder Trim Knob and Gearbox

The rudder trim knob is mounted on a shaft which extends vertically down through the aft cover of the pilots' pedestal. A gear near the top of the shaft drives the rudder trim indicator, which is visible through a window in the pedestal cover. A bevel gear with a ratio of 2.5 : 1.0 at the lower end of the shaft drives the forward trim cable drum. Stop washers within the cable drum limit drum rotation to 6.3 turns. Maximum trim knob rotation is approximately 15.75 turns from stop to stop. A hinged arm imbedded in the top of the trim knob can be flipped up and over to form a 4-inch crank to reduce pilot effort when changing the rudder trim setting.

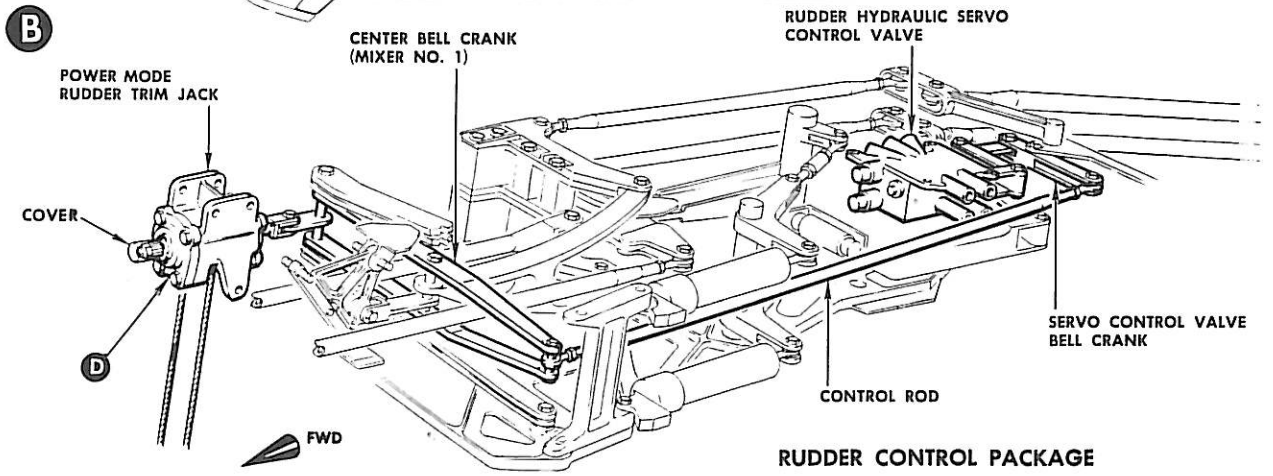
6. Rudder Trim and Trim Tab Jacks

The manual jack consists of a cable drum interconnected with dual screw jacks. The cable drum is mounted on a serrated shaft with spur gear (see Figure 2). This gear meshes with another spur gear on a parallel shaft. Each of these shafts includes a threaded inner shaft which constitutes the screw jack portion of the trim jack. The inner shafts are prevented from turning by serrations in the shaft housing. The outer shaft acts as a threaded nut on the inner shaft and rotation moves the inner shaft forward or aft according to direction of outer shaft rotation. This rotation provides push-pull movement for operation of the rudder trim tab.

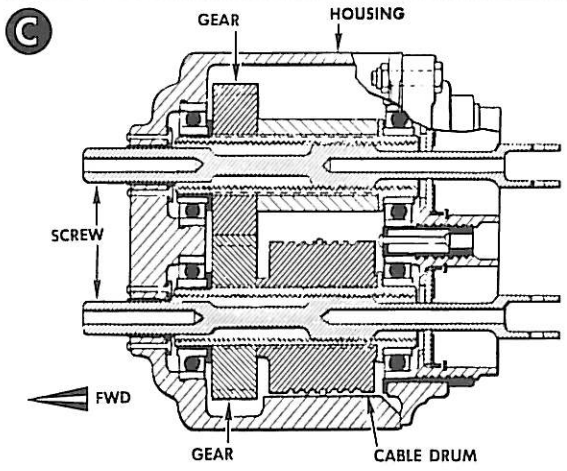
The power mode trim jack is the single screw jack type. Operation is similar to the trim tab jack. The power trim jack is mounted at the forward end of the rudder control package.



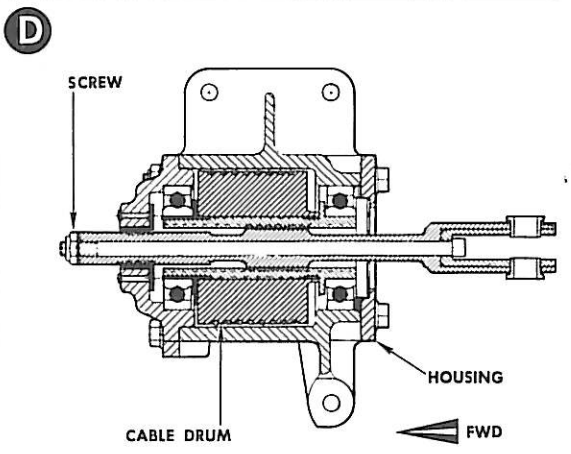
MANUAL MODE RUDDER TRIM JACK



RUDDER CONTROL PACKAGE



MANUAL MODE RUDDER TRIM JACK



POWER MODE RUDDER TRIM JACK

30.30.27.034A

RUDDER TRIM SYSTEM - TROUBLE SHOOTING

POSSIBLE CAUSE	ISOLATION PROCEDURE AND CORRECTION
1. EXCESSIVE FORCE REQUIRED TO ROTATE RUDDER TRIM KNOB	
A. Trim cables too tight.	Check tension of trim cables and adjust tension as required (refer to Adjustment/ Test Rudder Trim System Rigging Procedure).
B. One or more pulleys jammed or binding.	Rotate trim knob and observe rotation of each cable pulley. Repair or replace defective pulley.
C. Rudder trim jacks dry.	Lubricate trim jack assemblies as required.
D. Rudder control package jammed.	Check rudder control package; replace control package as a unit, do not repair.
2. RUDDER TRIM INDICATOR NOT AT ZERO WITH RUDDER, TRIM TAB, AND TRIM KNOB CENTERED	
A. Trim dial not set properly.	With rudder and trim tab centered, remove indicator cover, lift dial and rotate it to read zero. Check cable drum. If cables are not wound equally on each side, re-rig trim cables (refer to Adjustment/Test Rudder Trim System Rigging Procedure).
B. Cable not properly wound on trim jack drums.	Set trim knob at zero and check positions of drums in trim jack assemblies. There should be 3-1/2 turns of cable from cable fitting slot on each side of each drum. Center of bolts in clevis shall measure 1.35 (±0.03) inches from jack housing (measurement shall be 1.45 (±0.03) inches on trim jacks not modified per Service Bulletin No. A27-29A). Clevis in power trim jack should extend 2.45 inches from jack housing (measured from aft face of housing to center of bolt hole in clevis end). If cables are incorrectly wound on drums, adjust trim cables to center drum. If shafts do not extend correct distances, disconnect shaft from tab control and thread shaft in or out of jack as required.

POSSIBLE CAUSE	ISOLATION PROCEDURE AND CORRECTION
2. RUDDER TRIM INDICATOR NOT AT ZERO WITH RUDDER, TRIM TAB, AND TRIM KNOB CENTERED (CONT)	
C. Rudder trim tab control rods not adjusted to proper length.	With rudder trim jack shafts extending proper distance from jack housings and with rudder centered, check alignment of tab with rudder. If tab is not streamlined with rudder, adjust aft end of trim tab control rods to streamline tab with rudder. Tighten control rod lock nuts and install rods on trim tab horns.
3. EXCESSIVE PLAY IN RUDDER TRIM KNOB	
A. Rudder trim cables loose.	Adjust tension of rudder trim cables as required (refer to Adjustment/Test Rudder Trim System Rigging Procedure).
B. Rudder trim gearbox in pilot's pedestal defective.	Replace rudder trim gearbox assembly (refer to 27-2-1, Removal/Installation Aileron/Rudder Trim Control Gearbox).
4. IN POWER MODE, RUDDER AND TRIM TAB DO NOT CENTER WHEN INDICATOR READS ZERO TRIM	
A. Indicator dial not set properly.	Refer to trouble No. 2 and correct as required.
B. Servo valve linkage in rudder control package not correctly adjusted.	Adjust servo valve linkage as required (refer to Adjustment/Test Rudder Control System Rigging Procedure).
C. Rudder pedals not in neutral position.	Set gust lock to hold pedals in neutral position.
D. Rudder actuating cylinder rod ends not properly adjusted.	Adjust actuating cylinder rod ends (refer to Adjustment/Test Rudder Trim System Rigging Procedure).

RUDDER TRIM SYSTEM - MAINTENANCE PRACTICES

1. Adjustment/Test Rudder Trim System Rigging Procedure (see Figure 201)

A. Rudder Trim Tab Travel Data (see Figure 202).

Angular measurements are taken with a protractor installed on the trailing edge of the trim tab. A linear measurement is the straight line distance, in inches, between the noted point on the trim tab in the streamline position and the same point on the trim tab in the deflected position.

B. Equipment Required.

(1) Standard cable tensiometer.

(2) Tool No. 30-15000-901 RGTL # 1 for streamlining rudder with fin (see 27-7-0, Figure 203).

(3) Tool No. 30-15000-901 RGTL # 2 for streamlining trim tab with rudder (see 27-7-0, Figure 203).

C. Adjust Rudder Trim System.

(1) Turn control knob on pilots' pedestal until cables are wrapped equally on each side of cable drum (at least three turns from cable fitting slot).

(2) Check position of indicator dial on top of pedestal; if dial does not read zero, remove cover, lift dial, and rotate to read zero.

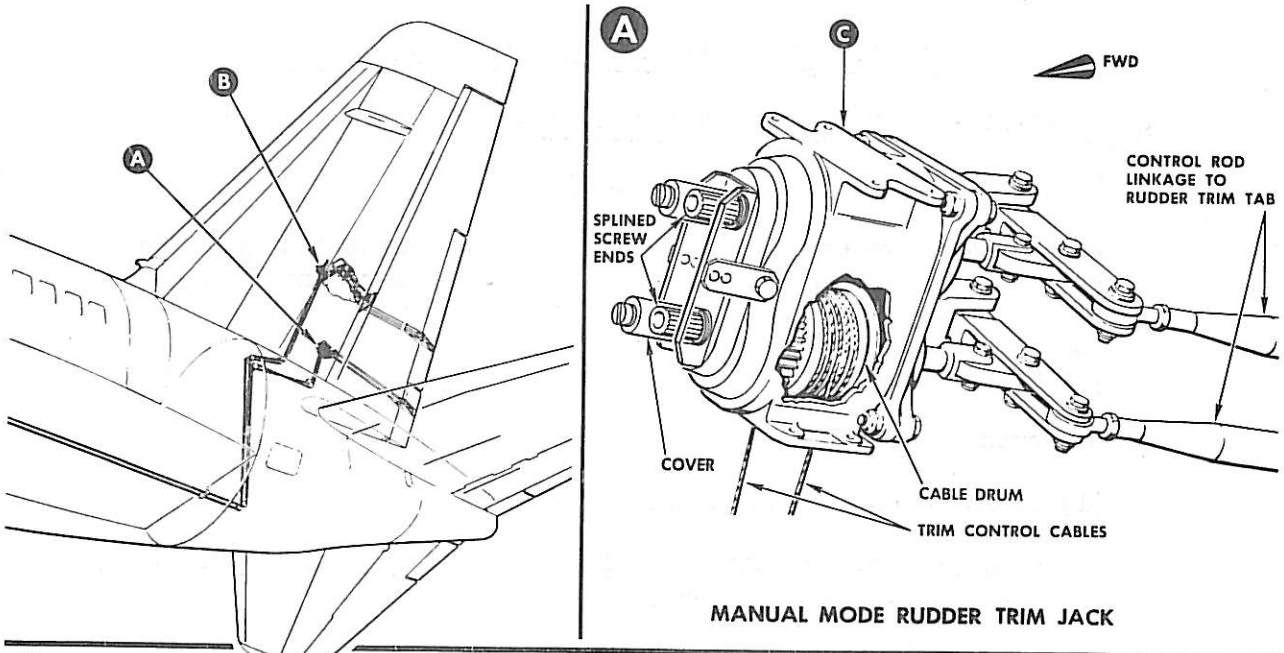
(3) Rotate drums in manual and power trim jacks so that cable is wrapped equally around each side of each drum. There should be 3-1/2 turns of cable around each side of each drum and cable ends from each drum should be even.

(4) Check extension of clevis from aft side of manual trim jack. Clevis should extend 1.35 (±0.03) inches from jack housing, measured from aft face of jack housing to center of bolt holes in clevis end.

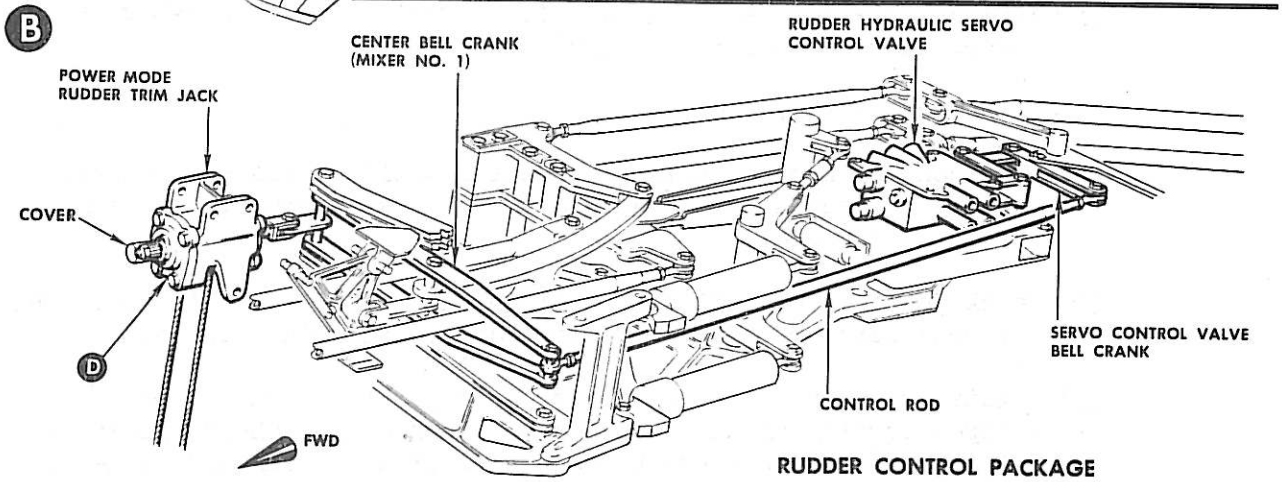
NOTE: Clevis should extend 1.45 (±0.03) inches from jack housing on trim jacks not modified per Service Bulletin No. A27-29A.

(5) Check extension of clevis from aft side of power trim jack. Clevis should extend 2.45 (±0.03) inches from aft side of trim jack housing, measured from aft face of housing to center of bolt holes in clevis end.

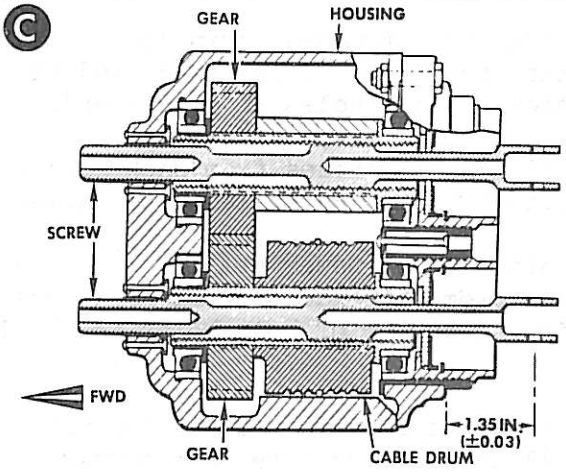
(6) Connect manual and power drum cables to forward trim cables with clevis and plate fittings in tail cone. Make sure that screws through clevis and plate fittings have a minimum of 0.020 inch axial movement after installation to prevent "clamping up" on cable fittings.



MANUAL MODE RUDDER TRIM JACK



RUDDER CONTROL PACKAGE



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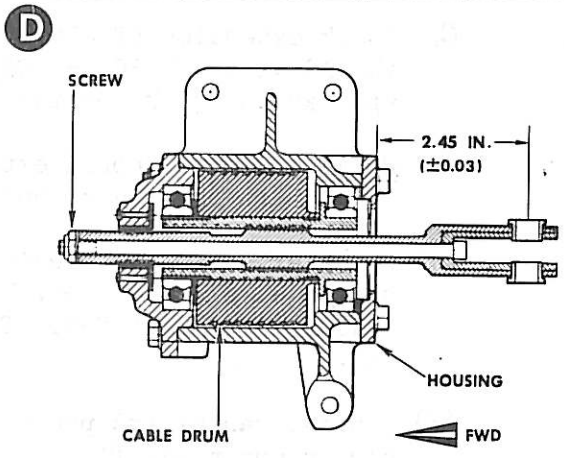
MANUAL MODE RUDDER TRIM JACK



POWER MODE RUDDER TRIM JACK

CONVAIR MODEL 30

MAINTENANCE MANUAL

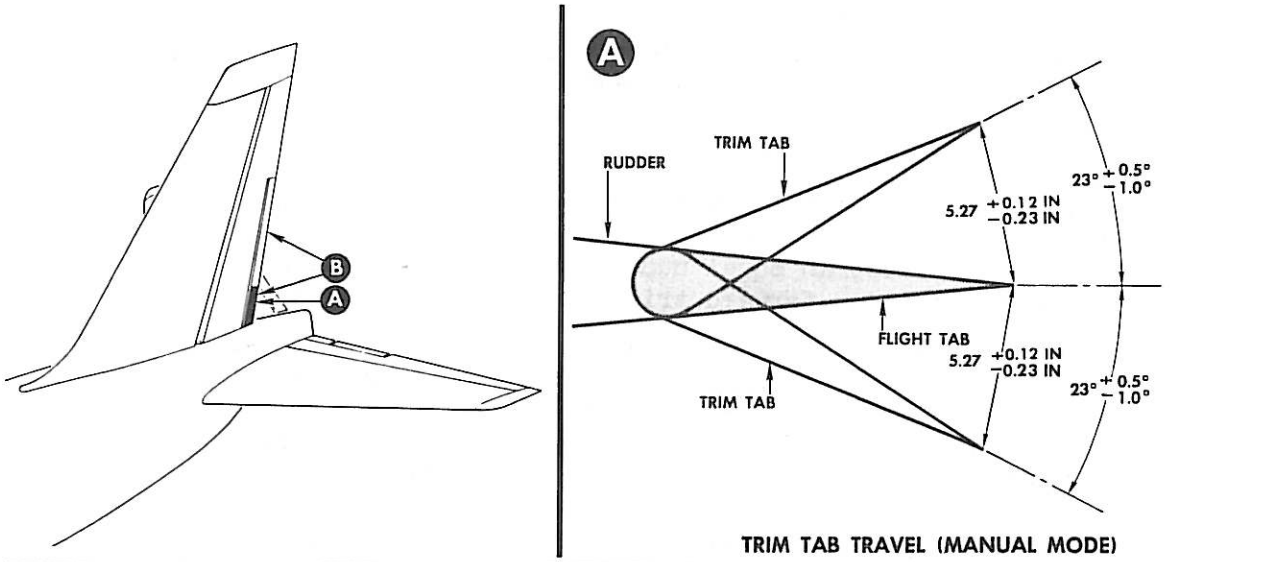
TEMPORARY REVISION NO. 27-21

Insert facing 27-8-0, Page 202, dated Aug. 27/62 (or subsequent).

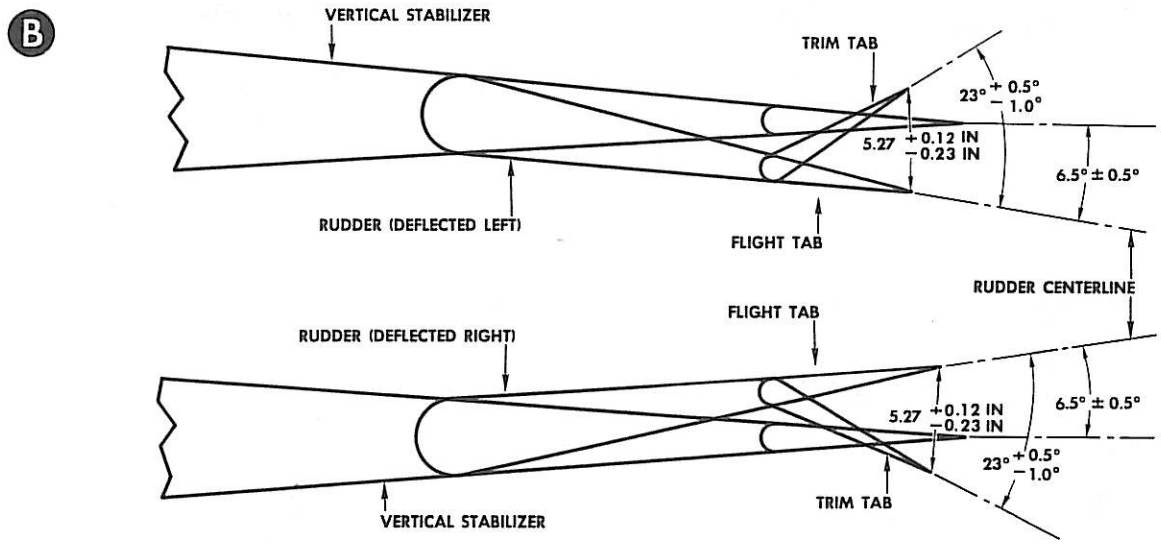
The instructions on the noted facing page are to be used for all applicable airplanes except as follows: for airplanes with trim jacks not modified per Service Bulletin No. A27-29A, substitute the following instructions where indicated.

Retain this Temporary Revision in your manual until all airplanes have been modified per noted Service Bulletin.

In view C, delete 1.35 inch measurement and replace with 1.45 inch measurement.



TRIM TAB TRAVEL (MANUAL MODE)



TRIM TAB TRAVEL (POWER MODE)

	ANGULAR DEFLECTION		LINEAR DEFLECTION		LOCATION OF POINT ON SURFACE FOR DETERMINING LINEAR MEASUREMENTS
	LEFT	RIGHT	LEFT	RIGHT	
TRIM TAB TRAVEL (MANUAL MODE)	23° +0.5° −1.0°	23° +0.5° −1.0°	5.27 +0.12 IN −0.23 IN	5.27 +0.12 IN −0.23 IN	SEE NOTE
TRIM TAB TRAVEL (POWER MODE)	23° +0.5° −1.0°	23° +0.5° −1.0°	5.27 +0.12 IN −0.23 IN	5.27 +0.12 IN −0.23 IN	

NOTE:

TRIM TAB
LINEAR MEASUREMENT IS TAKEN FROM A CENTER POINT ON TRIM TAB UPPER TRAILING EDGE TO A CENTER POINT ON FLIGHT TAB LOWER TRAILING EDGE WITH FLIGHT TAB STREAMLINE WITH RUDDER.

30.02.27.150 B

(7) Tighten rudder forward trim cables equally to a tension of 150 (± 10) pounds. Increase or decrease specified cable tension 0.5 pound for each degree F (1.0 pound for each degree C) increase or decrease respectively in free air temperature.

(8) Above point at which trim cables separate in tail cone, equalize tension of manual trim jack and power trim jack cable loops to within 10 pounds by loosening one cable loop and tightening the other cable loop an equal number of turnbuckle turns. Recheck tension of rudder forward trim cables and adjust as necessary.

(9) Turn trim knob, on pilots' pedestal, full travel to stop in one direction and then the other. Check cable drums each time to determine that cable does not unwrap from drum beyond cable attachment change of curvature. Cable must at all times be in a cable groove and not pulling straight out from cable attachment hole.

(10) Disconnect trim tab control rods from trim tab horns. Install tools No. 30-15000-901 RGTL # 1 and # 2 to secure rudder and rudder trim tab in streamline position (see 27-7-0, Figure 203).

(11) With rudder trim indicator reading zero and with trim cables wrapped equally around cable drums (refer to step (3)), adjust trim tab control rods to length between rigged tab and trim jack.

(12) Rotate trim control knob in clockwise direction. Trim tab shall move to left and power trim jack shaft shall retract.

(13) Safety all turnbuckles with NAS651 clips.

2. Adjustment/Test Rudder Trim System Functional Test

A. Equipment Required.

(1) Stand suitable for reaching rudder and rudder trim tab.

(2) Tool 30-15000-901 RGTL # 1 to secure rudder in streamline position and to measure rudder travel.

(3) Spring scale calibrated from one to ten pounds.

(4) External source of hydraulic power.

B. Check Rudder Trim Tab Free Play.

(1) Install tool 30-15000-901 RGTL # 1 and secure rudder in streamline position (see 27-7-0, Figure 203).

CAUTION: DO NOT SECURE RUDDER WHEN EITHER HYDRAULIC SYSTEM IS PRESSURIZED.

(2) Attach spring scale to trailing edge of trim tab directly aft of control rod attaching horns.

(3) Using spring scale, pull trim tab to right until five pounds is indicated on scale.

(4) Maintain five-pound pull on trim tab and, with a soft-lead pencil, mark position of trim tab trailing edge on top of fuselage.

(5) Release tension on spring scale.

(6) Pull trim tab to left until five pounds is indicated on scale. Maintain pull on scale and mark position of trim tab trailing edge. Release tension on scale.

(7) Measure distance between two marks on fuselage. Distance between marks indicates trim tab free play and shall not exceed 0.05 inch.

(8) Remove rudder locking tool.

(9) Erase pencil marks on fuselage.

(10) Remove spring scale.

C. Check Rudder Trim.

Rudder trim is checked with hydraulic power on during rudder control system functional test. For rudder trim check, refer to Adjustment/ Test Rudder Control System Functional Test).

RUDDER TRIM TAB - MAINTENANCE PRACTICES

1. Removal/Installation Rudder Trim Tab (see Figure 201)

A. General.

The rudder trim tab does not require balancing and its installation will not affect rudder balance if the weight of the tab does not exceed 10.88 pounds. Trim tab weight is stamped on tab nameplate. If trim tab is not within weight tolerances, the rudder must be rebalanced (refer to Structural Repair Manual).

B. Equipment Required.

(1) Stand suitable for reaching lower part of rudder and vertical stabilizer.

(2) Tool 30-15000-901 RGTL # 1 for streamlining rudder surface with vertical stabilizer.

(3) Tool 30-15000-901 RGTL # 2 for streamlining rudder trim tab with rudder.

(4) Graphite grease, Specification MIL-G-7187.

(5) Torque wrench calibrated in inch-pounds.

C. Remove Rudder Trim Tab.

(1) Remove screws that attach small hinge fairing plates and forward section of control rod fairing to left side of trim tab.

(2) Remove screws and open rudder No. 2 hinge support access door on left side of vertical stabilizer.

(3) Disconnect aft ends of trim tab control rods from trim tab horns.

(4) Remove bolts and washers attaching bonding jumpers to the rudder (three places).

(5) Remove nuts and washers from the trim tab hinge bolts (three places).

(6) Support trim tab and remove hinge bolts; remove trim tab. Retain cone bushings used at each hinge.

D. Install Rudder Trim Tab.

(1) Place trim tab in position and align hinge fittings.

(2) Apply graphite grease, Specification MIL-G-7187 to the outside surface of each cone bushing and insert cone bushings in each side of the trim tab hinge fittings.

NOTE: Maximum allowable gap between bushing and bearings is 0.005 inch prior to tightening hinge bolts. Insert support blocks between hinge lugs and bearing and tighten hinge bolt nuts to press bushings against bearings. Loosen nuts and remove support blocks (see 27-0, Figure 204).

(3) Tighten nuts and torque to between 50 and 70 inch-pounds.

(4) Install bolts and washers attaching bonding jumpers to rudder.

(5) Install tool 30-15000-901 RGTL #1 to streamline rudder surface with vertical stabilizer (refer to 27-7-0, Figure 203).

(6) Install aft ends of trim tab control rods on trim tab horns.

(7) Adjust rudder trim control knob on pilots' pedestal until center of hole in clevis measures 1.35 (±0.03) inches 1.45 (±0.03) inches on trim jacks not modified per Service Bulletin No. A27-29A) from aft face of trim jack housing. Rudder trim indicator should read 0 degree. If it does not, remove cover, lift dial, and rotate to read 0 degree.

(8) Install tool 30-15000-901 RGTL #2 between rudder trim tab and rudder flight tab (see 27-7-0, Figure 203).

(9) Check position of trim tab. If trim tab is in streamline position, continue with Step (13). If trim tab is not in streamline position, disconnect forward ends of trim tab control rods, use tool 30-15000 -901 RGTL #2 to secure trim tab in streamline position, adjust one trim tab control rod to length between secured trim tab and trim jack, and install control rod on appropriate trim jack lever.

(10) Move trim tab to full right position and adjust trim tab control rod not installed in Step (9) to length between trim jack and trim tab so attachment bolt may be inserted and removed freely. Do not install nut.

(11) Move trim tab to full left position and attempt to insert bolt. For final adjustment, attachment bolt must be inserted and removed freely when trim tab is in either full travel position.

(12) Install bolt and tighten check nut on rod end.

(13) Test system (refer to 27-8-0, Adjustment/Test Rudder Trim System Functional Test).

NOTE: If the rudder trim tab only has been replaced and no other rigging or adjustment has been changed, check rudder trim system operation per 27-8-0, paragraph 2.B., and 27-7-0, paragraph 2.G.

(14) Install trim tab hinge fairing plates, forward section of trim tab control rod fairing, and close rudder No. 2 hinge support access door.

CONVAIR MODEL 30

MAINTENANCE MANUAL

TEMPORARY REVISION NO. 27-57.

This temporary revision supersedes Temporary Revision No. 27-22, dated Aug. 27/62.

Insert facing 27-8-1, Page 203, dated Aug. 27/62 (or subsequent).

The instructions on the noted facing page are to be used for all applicable airplanes except as follows: for airplanes with trim jacks not modified per Service Bulletin No. A27-29A, substitute the following instructions where indicated.

Retain this temporary revision in your manual until all airplanes have been modified per noted service bulletin.

In view G, delete 1.35 inch measurement and replace with 1.45 inch measurement.